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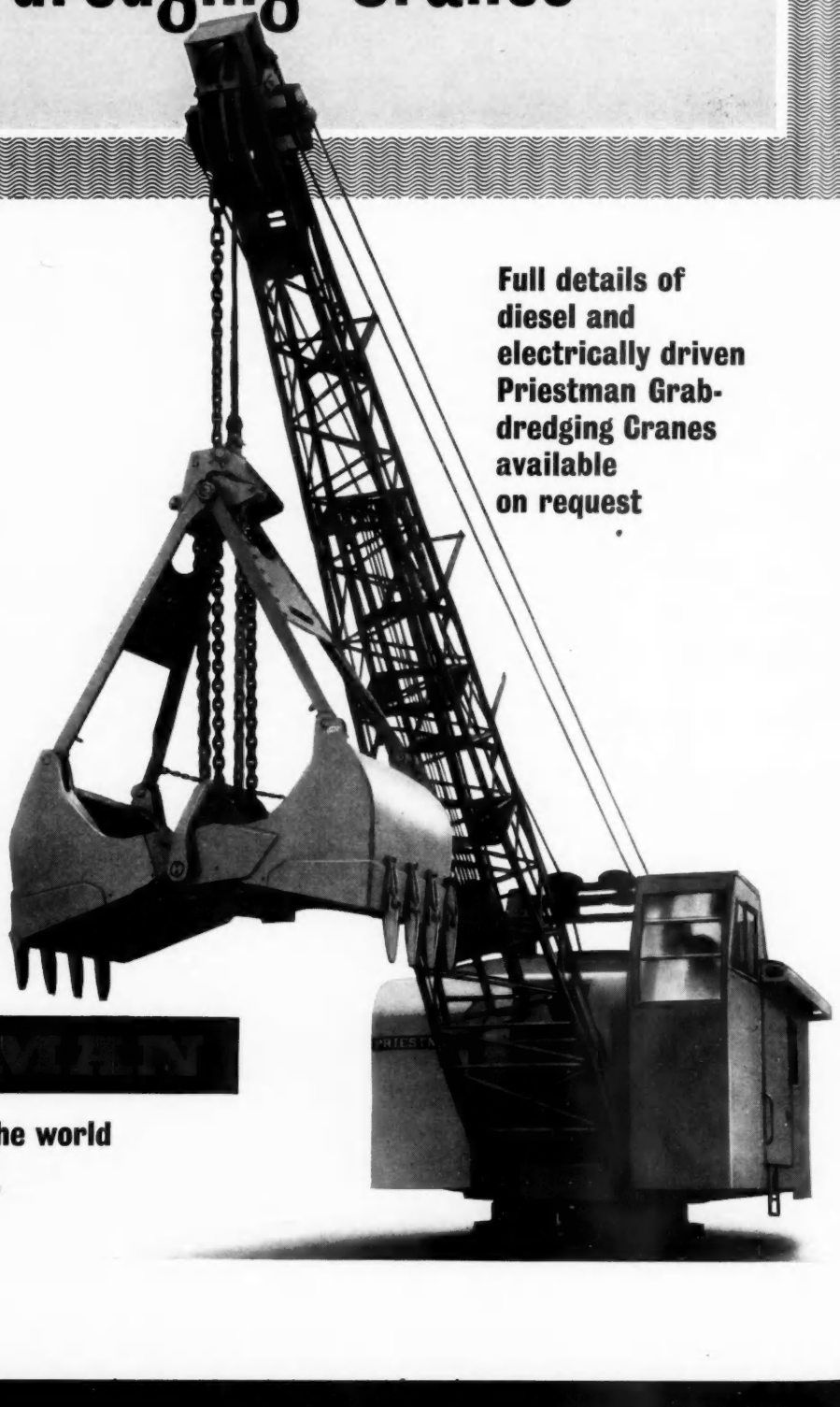

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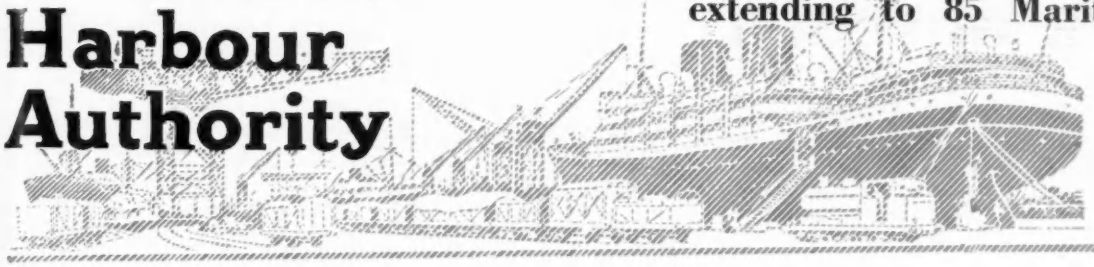


Editorial Notes

The Port of Auckland

Auckland, the largest city and leading port of New Zealand, is situated in beautiful surroundings, and its harbour, sheltered by an outlying chain of islands, affords accommodation to large vessels at the lowest tide.

The city was founded by Governor Hobson in 1840 as the original capital of New Zealand and, during the years that inland communications were non existent, it capitalised its position as the natural focus of shipping routes, both coastal and overseas. The seat of government was removed to Wellington in 1865.

The Provincial District of Auckland owes its prosperity and rapid increase of population to the settlement and development of magnificent dairying lands to the north and south of Auckland, and to the subsequent construction of railways and good roads which have facilitated transport.

We are indebted to Mr. A. C. Clarke, the general manager to the Auckland Harbour Board, for the informative account of the Port and its facilities which forms the leading article for this issue.

Auckland, in common with other ports of the country, has to deal with the handling and cold storage of dairy produce for export. This is a matter of vital importance to a variety of industries in New Zealand which are concerned in the administration and operation of the various stages of the journey from the farms to overseas markets. The problem of efficient and economical handling, and of providing adequate and suitable accommodation and facilities has engaged the attention of the Auckland Branch of the New Zealand Institution of Engineers who in August last, convened a one-day conference on the Transport and Handling of Export Produce. A symposium of six papers was presented, and as the subjects discussed constitute an important aspect of world trade in which many of our readers in other countries are engaged, we propose to publish extensive abstracts from the papers in our April issue.

The Handling of Refrigerated Cargoes

It will be appreciated from the foregoing that refrigeration has played and continues to play an important role in the development of the countries comprising the British Commonwealth. An interesting account of the growing importance of this industry to the shipping world was given by Mr. F. E. Harmer, C.M.G., in a lecture entitled " The Refrigerated Cargo Liner," which was delivered in London last month to the Institute of Transport. Short abstracts from his paper are printed on a following page.

In his introductory remarks, Mr. Harmer pointed out that, by the beginning of the nineteenth century, the European countries had largely become industrialised and with their populations growing yearly, they could no longer be self-supporting in foodstuffs. They therefore began to import food in large quantities.

The normal development of ships sufficed to keep pace with the import of grain, which could be carried under the usual conditions of carriage, but where foods such as meat and dairy produce were concerned it was found impossible to carry them long distances in all conditions of climate in the ordinary ships' holds. The new countries such as New Zealand, Australia and South America had food to spare and the Old World was acutely in need of it but the produce was perishable and there was no bridge between the two.

At this stage salting, drying and chilling were known methods of preserving foods, if not indefinitely at least for some length of time, and had been used in various ways since the earliest days of civilisation. The principles of thermo-dynamics were now studied actively and, after them, the principles and practice of refrigeration. The forerunner of the modern refrigerating machine appeared around 1834, and the first frozen meat works in the world was opened in Sydney, New South Wales, in 1861. Twenty years later the first refrigerated cargo of meat and dairy produce from New Zealand successfully arrived in London and the link between the producer and the consumer countries was established. Since then refrigeration technique has steadily improved and to-day New Zealand and Australia alone export well over half a million tons of meat to the rest of the world, together with substantial quantities of dairy produce.

The commercial applications of refrigeration are still increasing and with the growth of refrigerated cargoes it has become necessary to provide adequate facilities to receive and store them at the ports. This problem is to some extent aggravated by the cargoes being in many cases a seasonal traffic and the provision of cold stores and of modern methods to expedite the handling of this traffic is becoming increasingly important.

An Interim Policy for British Canal Development

The problems raised by Britain's 2,000 miles of canals and navigable rivers have largely been those of finding practicable means rather than ends. Classification of these into those which now render a substantial economic service, those which might do so with encouragement and those for which no traffic potential can be foreseen has hardly changed since the Board of Survey of 1954.

The Government White Paper, just issued, is reported on a later page. Evidently, the Government is not yet ready to accept fully some expensive measures advocated by the Bowes Committee last year. Decisions on some of the controversial issues are to be delayed for at least two years. Meanwhile, interim policies are proposed.

The main effort will be directed to the development of those waterways which can accommodate vessels large enough to operate in Docks and Estuaries. These are the waterways which now operate profitably and render a real service towards the relief of dock congestion. Detailed engineering and economic surveys are to be made to assess the prospective value of new or enlarged waterways of this type, to join the Midlands both with London and the Mersey.

During the experimental period a new Inland Waterways Redevelopment Advisory Committee will give technical advice and help on several issues. Much will depend upon the membership of this body and particularly upon the Chairman. He must demonstrate his independence of the Transport Commission, without, however, any tendency to regard that much criticised body with unjustified suspicion. New policies and fresh ideas, many of them leading to expansion of inland water transport or involving novel solutions to old problems, must be pursued, although these will be limited by financial restrictions. While the experiment is in progress, essential experience will be gained

Editorial Notes—continued

and a decision will be easier on the question upon which the Bowes Committee split. The canals in the second class will receive some encouragement, without the subsidy which the Committee considered inevitable; their full restoration, with a guarantee that they will be so maintained for twenty-five years, must be delayed. Finally ways to secure a worthwhile future for the apparently less viable canals should become clearer. Perhaps the National Trust will be found to have an important part to play in channelling public interest realistically without the sentiment and prejudice which has regrettably often accompanied enthusiasm.

Mechanical Marshalling of Railway Wagons

A paper important to all concerned with the planning or operation of railway goods sidings was recently published by the Institution of Mechanical Engineers. Mr. G. W. Grossmith, the author, reviews the rapid post-war development of the mechanical marshalling of wagons by means other than those which were already established during the building up of the railways in the nineteenth century.

Where coal, ores or other bulk materials are handled to or from railway wagons at a fixed terminal point in a dock or harbour, the authorities concerned are now giving close attention to the advantages offered by modern wagon handling methods. As a result, many of the traditional operations and labours associated with the handling of this type of cargo will probably be superseded, and manual labour will be replaced by mechanical methods and new devices of very recent development.

For this reason we believe that the reproduction in these pages of the relevant parts of Mr. Grossmith's paper will be of value to many port authorities, whether in regard to the modernisation of existing facilities or the planning of new installations. We also hope that the details given may provoke some thought among those responsible for the operation of a dock or quay wherein railway wagons are delivered for on or off-loading to ship-side tracks. There is little doubt too that there are cases in the planning of new quay layouts, particularly at congested sites, where the reduction in the total length of tracks required, as well as the additional speed and safety of operation afforded by a mechanical system of wagon handling, would be well justified.

We are not aware of any case of a general service river or dock-side quay being provided with modern mechanical marshalling facilities, but we believe that there is ample room for such development.

Shipping and Dock Matters

The annual report of the Chamber of Shipping of the United Kingdom is of more than usual interest. It is lucidly written and the dangers which British shipowners see facing their industry are expressed in forthright terms. Throughout the report there are references to matters of particular concern to dock authorities. On the question of delays to shipping, for example, it is observed that the strike-free record of 1956 and the almost strike-free experience of 1957 were marred in 1958 by the unofficial strike at the London docks in June. This resulted in the loss of 330,000 man days and was the twelfth major unofficial stoppage of labour in the London docks in the past ten years. The cost of these stoppages, both to the nation in general and to the shipowners affected in particular is, as the report points out, incalculable and their effect on the trade of the country is most damaging. Overseas markets once lost to foreign competitors may never be regained and coastwise traffic lost to inland transport may never be recovered.

Nuclear power casts its shadow over the report. There is reference to a new indemnity to carriers and stevedores covering explosives for " visiting forces " handled in the United Kingdom port areas not having been brought into operation, so that the position remains as it was, which means that individual indemnities have to be sought by the liner companies concerned. However a further indemnity, supplementary to the explosives indemnities which the Government has given in the past in connection with Government explosives, has been agreed by the British Liner Committee with the Ministry of Supply. It applies to the owners of private wharves in the United Kingdom.

On the larger aspect of safety in the peaceful use of atomic energy—an important aspect of its marine application—shipowners and seafarers are represented on the committee set up by the Ministry of Transport to advise the Minister " on the safety problems arising from nuclear power in merchant ships at sea and in port." Other interests likely to be affected by the building and operation of nuclear ships in ports and harbours are also represented on this " Committee on the Safety of Nuclear Ships." Its work is as yet only in the early stages. Its immediate concern is to prepare for the International Safety Conference to be held in London in 1960 and to have ready a code of practice to regulate the use of United Kingdom ports by nuclear ships of other countries, particularly the United States n.s. " Savannah," which is expected to visit Britain next year.

Reference is made to the fact that a number of port authorities found it necessary to introduce increased charges because of rising costs and declining trade. The latter reason for raising dues, it is pointed out, raises a real problem and is always the subject of most careful consideration. It is obvious that where trade is declining there is considerable risk of any increase in dues having the reverse effect of that intended, owing to the law of diminishing returns.

Flag discrimination has now displaced flags of convenience as the greatest menace to British shipping. Sir Nicholas Cayzer, the new president, said in his inaugural address that flag discrimination, subsidies and flags of convenience could drive the Red Ensign from the seas. He added: " We are quite determined that it shall not be driven from the seas."

New Mechanised Steel Handling Berth in Melbourne

The Melbourne Harbour Trust has recently placed into commission at No. 21 South Wharf a new berth which has been designed for the efficient mechanised discharge from ships of structural steel sections and other steel and iron products.

The wharf apron and shed floor extend back a total distance of 198-ft. from the edge of the wharf, and 132-ft. of this is roofed over. The shed is 420-ft. long, consisting of seven 60-ft. bays.

Mechanical equipment provided at the berth comprises four 6-ton level luffing wharf cranes and six 6-ton overhead travelling or shed cranes. All of the wharf cranes and four of the shed cranes are provided with equipment for energising and handling electro-magnets. All cranes are cabin-controlled.

The overhead travelling cranes run on elevated extended tracks so that they may travel out in front of the roofed area and pick up steel deposited from the wharf cranes. The tracks also are extended over the roadway so that the cranes can plumb a point 20-ft. behind the rear of the floor and load the steel directly into road vehicles for transport away from the area.

Two of the wharf cranes are each equipped with two independently operated hooks by means of which long bars may be tilted into an inclined position so that they will more readily pass through the hatch openings. All of the shed cranes are provided with lifting beams each with a number of hooks for the readier handling of long plates and bars. No provision is made for tilting the lifting beams.

Structural steel sections and other products are, as far as possible, shipped in bundles with the slings already attached. The wharf cranes deposit these bundles on the area directly in front of the roofed portion of the shed, and the shed cranes can then pick up and stack the bundles until they are ready to be loaded (also by the shed cranes) into road vehicles for removal. When convenient the bundles can be loaded direct into road vehicles drawn up on the wharf apron.

The use of the berth for the mechanised handling of iron and steel has greatly shortened the length of time a ship must stay in port, whilst the number of tons of steel discharged per man hour has quadrupled.

In the case of the discharge of pig iron by magnet the savings in labour are even more spectacular. One quarter of the number of men can discharge a ship in half of the time previously required for other methods.

The centralisation of iron and steel handling at No. 21 South Wharf is freeing for other uses four berths which hitherto have been used virtually full-time in the handling of these cargoes.

The Port of Auckland

Progressive Development of Modern Facilities

By A. C. CLARKE (General Manager, Auckland Harbour Board).

Introduction

THE Port of Auckland, New Zealand, is situated in the Hauraki Gulf in the Northern part of the North Island. The Waitemata Estuary, i.e. the Northern section of the Gulf, has a total area of 77 square miles. It is completely sheltered by an outlying chain of islands and by the peninsula at the Northern Entrance. Its geographical position is: latitude 36 deg. 49 mins. 56 sec. S and longitude 174 deg. 47 mins. 57 sec. E. The inner or commercial harbour has a length of 54 miles and an average width of 1 mile.

Through the port, which serves an area of 3,500 square miles and a population of almost half a million people, flows over one-third of New Zealand's imports and over one-fifth of New Zealand's exports. Nearly 80% of the butter shipped from New Zealand is handled at Auckland. The hinterland of the port covers an extensive and extremely productive area; from the rich, fertile plains of the Waikato River basin and the Northland plains to the undulating and hilly country around the perimeter. Pastoral production of this area includes butter, wool, frozen meat and offal, cheese, hides and skins, etc.

The Auckland Harbour Board is a self-governing body comprising 15 members elected by popular franchise from the municipality and outlying areas within the Harbour Board District. A system of committees deals with the bulk of the work, these committees reporting their recommendations to the full Board.

A staff of some 1,200 are employed by the Board on the administration, operation and maintenance of wharves, plant and equipment. Gross revenues from all sources, which includes, charges on shipping, goods and rents, and from leasehold properties, exceeds £2 million. Of this sum, operating and maintaining expenses amount to over £1¼ million, the balance being interest on loans, redemption of loans, etc.

Growth of the Port

The decision of Captain Hobson, the Lieutenant Governor of the Colony in 1840, to site the new capital on the southern shores of the harbour, was vindicated by the development which has taken place over the century of its existence. The transformation from a scene of fern or tree-clad gullies unmarked by the hand of man, to a port of considerable local importance was achieved in a matter of twenty years.

The population of Auckland in 1858 was 6,283. Not only had the town grown but many immigrants had taken up land around the capital. The products of the natural fertility of the soil and the impetus given to the trade by the discovery of gold at Coromandel some 70 miles from Auckland, swelled the trade of the port to a value of over £500,000. By 1860, 83 overseas vessels entered the port. Facilities at this date were very limited, comprising two jetty-type wooden wharves, Queen Street Wharf and Wynyard Pier.

By 1910 the poulation of the city was over 100,000 and of the Province over 250,000. The city was a commercial centre of the first rank. The productivity and requirements of Auckland's hinterland had greatly increased. Facilities had been considerably improved to enable the port to deal with the increased shipping. The foreshore had been greatly extended by reclamations and four finger-type wharves and two jetties had been constructed. The value of the trade of the port in 1910 was: Imports £4,741,326 and Exports £3,960,655.

Auckland is to-day provided with extensive port facilities, the waterfront in the port area being entirely man-made. The extensive Western Reclamation provides flat land for bulk oil storage west of the central port area. East of what was previously Point Britomart, considerable reclamation work has provided land for off wharf storage, for warehouses, and for the railway station, goods sheds and marshalling yards. These railway facilities are particularly important for the working of the port. In total the Auckland Harbour Board has reclaimed three hundred and seventy-five acres of valuable land adjacent to the commercial heart of the city, much of which is itself sited on land won from the harbour.

Seven city wharves lining the waterfront near the central commercial area provide a total berthage space of 27,000-ft. Rather more than half of this space is usually available for overseas vessels and the remainder for coastal shipping. Berthage space for overseas vessels is served by railway sidings connected with the New Zealand Government railway system. On the other hand berths used by coastal shipping are largely dependent on motor truck transport.

There is no specialisation of wharves in regard to the type of coastal cargo handled. Ships are directed to whatever berth is at the time available.

Facilities for overseas shipping show some specialisation; oil tankers discharge at either Wynyard Wharf or at the Eastern Tanker Wharf. Butter for export is loaded at Bledisloe Wharf which is supplied from two nearby cool stores.

Port Labour

The Port Labour Force is divided into two main sections, those employed by or on behalf of the shipping interests and those employed by the Harbour Board.

The Maritime Cargo Workers Union numbering about 1,700 men provides the labour to perform the work of loading and discharging vessels and are engaged in terms of a waterfront principal order under a bureau system of allocation, administered by the Waterfront Industry Commission. Under the bureau system of engagement of labour the employer (in this port either the shipping companies or stevedoring companies under contract to the shipping companies) requisitions for the labour he requires and the bureau allocates to him accordingly. The allocation is for the most part purely mechanical and consists in attracting labour with the least employment to its credit to the employment required. The work is rotated and each worker gets an equal share. The labour works under the gang system, that is, they are grouped together in a gang, they are employed as a gang and work together as the one unit. The co-operative contract system is worked in the port, whereby in addition to wages, the profits from the contracts are paid to the workers as a bonus.

The Auckland Harbour Board employs permanent drivers to operate its quayside cranes and mobile cranes, fork-lift trucks and tractors and trailers. This operational section of the Board's staff numbers 222 added to which are the shed supervisory staff, traffic officers and gatekeeping service numbering 150. The mobile plant is ordered as required by the shipping companies and charged on an hourly basis which includes the drivers wages. The normal working hours in the port are 8 a.m. to noon and 1 p.m. to 5 p.m. Mondays to Fridays inclusive and overtime is worked from 6 p.m. to 9 p.m. Monday to Friday and 8 a.m. to noon Saturday. Extended hours are only worked in exceptional circumstances.

Butter Conveyors

The Port of Auckland handles over 5 million boxes of butter each year, representing 80% of all New Zealand's exports of this commodity.

The system of loading in vogue, prior to the construction of the conveyor-system was—the butter which was stored in a large refrigerated store on the waterfront area was loaded into special insulated rail wagons and shunted to the quayside. The butter was then man-handled out of the wagons on to cargo boards and hoisted by quayside cranes into the ship's hold. This system

The Port of Auckland—*continued*

involved double handling of the butter as well as the necessity to shunt the wagon through the marshalling yards to loading berths in the port.

Honouring an undertaking to construct a wharf suitable for loading refrigerated cargo and particularly butter, adjacent to the large butter store on the waterfront, the Auckland Harbour Board built Bledisloe Wharf where butter can be delivered from the store to ship's side at a steady rate of 5,000 boxes an hour to each berth by means of a series of conveyors.

There are two berths, each served by four lines of conveyors, each line having a rated capacity of 1,250 boxes an hour without being overloaded.

The wharf can later be extended to four berths and the number of conveyors doubled if necessary.

In the cool store the butter is handled on each floor by belt conveyors which connect with vertical elevators running the full height of the building. Both conveyors and elevators are reversible, allowing butter to be loaded in or out of the chambers and raised or lowered from floor to floor as required.

The Board has provided a further series of conveyors connecting with the conveyor system of the cool store and extending it to the ship's side. An overhead bridge leads from the sixth floor of the cool store to the flat roof of the cargo shed on

Fig. 1. Transporter crane with clam shell type grab, for handling bulk sugar.

Bledisloe Wharf. Eight lines of belt conveyors pass through this bridge and continue along a covered galley running the full length of the roof. Each line of the conveyors is divided into several sections connected by a short length of gravity roller runway. The butter can pass from section to section along the whole length of the conveyor line or can be diverted to any loading point by removing one of the connecting runways and replacing it with a curved turn-out. Thus, by the use of conveyors, any block of butter in the cool store can be delivered to any required hatch of a loading ship.

The whole system is operated electrically, being controlled by push button from the point of delivery, and an internal telephone system allows the work in the store to be kept in step with work at the ship.

Bulk Sugar Handling

Bulk sugar is handled at a wharf, owned and maintained by the Colonial Sugar Refining Co. Ltd., on the North side of the harbour about three miles from the main port area.

The sugar arrives as loose bulk in the holds of ships which tie up at a wharf adjacent to the Refinery. There is a transporter crane (fitted with a clam shell type grab) which can move back and forth along the wharf and which has a boom 50-ft. above the wharf (Fig. 1). The operator sits in a cabin attached to the boom in a position above the hatch being worked. The boom is hinged so that it is raised to clear masts and other ship's gear when moving from hatch to hatch.

The crane grabs 3 tons of sugar at each bite and discharges directly into a hopper which feeds a series of continuous conveyor belts which take the sugar into the stores or process. At the start of operations the crane moves from hold to hold according to the trim of the ship and about 75% of the sugar in each hold is removed by the grab without the assistance of ancillary equipment.

After this initial sugar has been removed, additional mechanical gear is placed in the hold using an auxiliary jib attached to the crane. This gear consists of Muir Hill loaders plus a sugar thrower. This equipment is used to shift the sugar from under the wings out into the centre of the hatch, where it is available to the clam shell.

While the auxiliary gear works in one hold the crane works on other hatches. As soon as the last hold is finished the

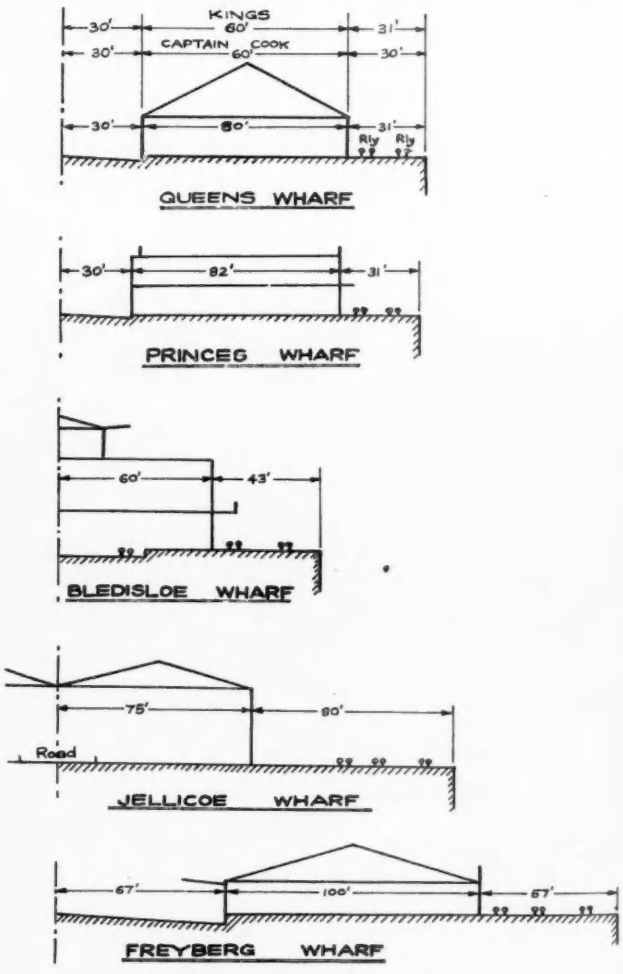


Fig. 2. Half-sections of wharves.

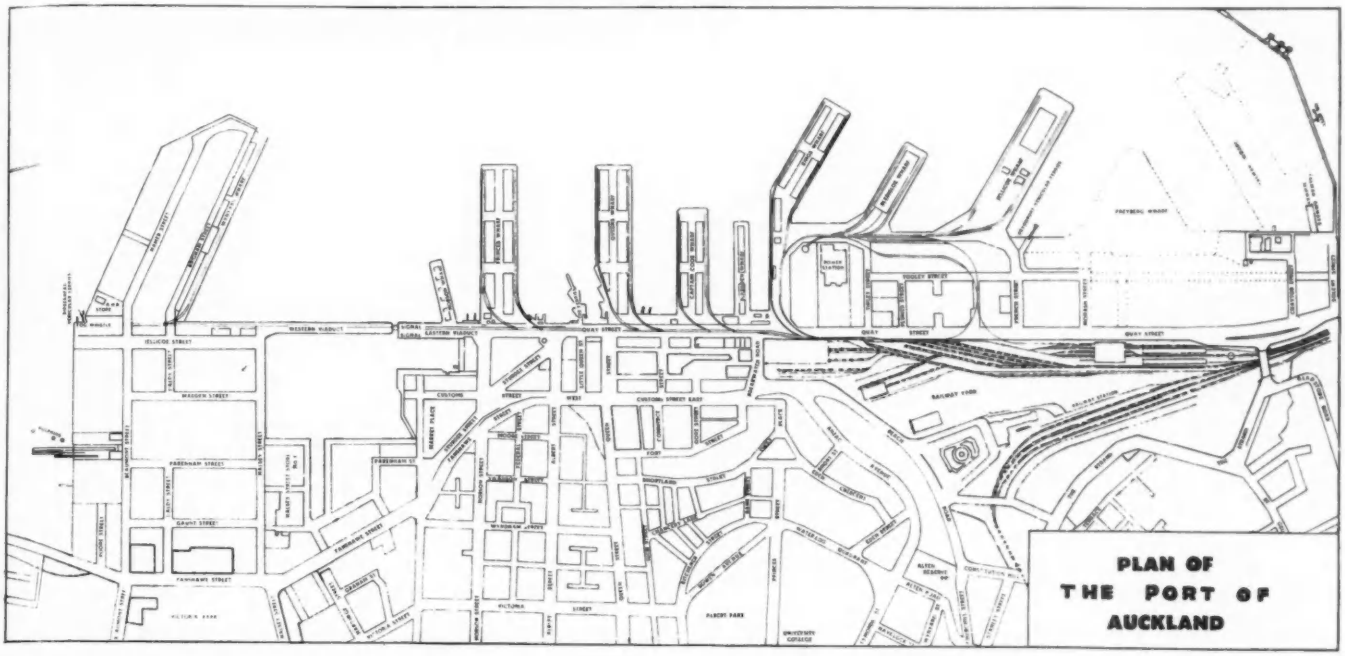
equipment is withdrawn, the hatches replaced and the ship is ready for sea.

The method of working is designed for continuous 24 hour a day operation and a 6,000 ton cargo is unloaded within four days.

Typical Wharf Layouts

Berthage development in this port has been on the basis of jetties or finger piers since the marginal quay or wharf type of construction is not suited to the foreshore along which the port has been developed. The restrictions innate in the finger pier construction are particularly evident when the modernisation or adoption of such structures is contemplated to meet the requirements of modern cargoes and modern cargo handling plant.

The Port of Auckland—continued



An aerial view of the waterfront area. [Whites Aviation Photograph]

The Port of Auckland—continued

Fig. 3. The steam tug "Aucklander" in working trim.

As can be seen from the accompanying diagram (Fig. 2) Queens Wharf built in 1910 and Princes Wharf built in 1922 both have quays 31-ft. wide equipped with two flush rail tracks, and an 80-ft. wide shed with a continuous loading bank fronting a 60-ft. wide central roadway. Both structures are of reinforced concrete piled construction and carry semi-portal quay cranes of 3 and 5 tons capacity.

Bledisloe Wharf built during World War II has 43-ft. wide quays with a 120-ft. wide shed, the ground floor of which accommodates a central sunken roadway, two rail tracks and loading platforms. It is a reinforced concrete piled structure equipped with semi-portal quay cranes and two flush rail tracks in each quay. The wider quay and wider spaced rail tracks were designed to facilitate the breaking out and slinging of frozen cargoes ex rail wagons and in this regard has been very successful. The ground floor arrangement however is quite unsuited to working tractors, trailers and fork hoists or for storing any quantity of cargo. The wharf was designed to specialise in export cargoes and its wide quays and butter conveyor at roof level work very well.

In the Jellicoe Wharf built in 1952 the desired effect was a four berth wharf of which the two inner berths were to be for bulk handling of phosphate, coal, sulphur and similar imports whilst the outer berths were to be for rough and general cargoes with consequently restricted shed accommodation. Both quays are much wider than previously and equipped with full portal cranes, spanning three rail tracks. This three track layout has been welcomed by the stevedores and is particularly popular for frozen exports. It is also well suited for handling rough imports such as timber, steel and drums.

In Freyberg Wharf now under construction the three track layout has been adhered to on a quay width of 57-ft. with a single storey shed 100-ft. wide with a continuous loading bank fronting the roadway. This wharf is triangular in plan with a base 800-ft. wide. It will provide two berths each 700-ft. long and will possess most of the advantages of marginal quay construction. It will be a general purpose wharf equally capable of efficiently handling general imports through the shed or frozen exports off the quay. This wharf with transit sheds, electric portal quay cranes, ancillary building and services and dredging of berths is expected to cost £2,500,000 and to take 3¼ to 4 years to complete. A further wharf consisting of two 650-ft. berths, to be known as the Tasman Wharf, is to be constructed between Freyberg Wharf and the Eastern Tide Deflector to handle general cargo.

Tugs

The wharves in this port lie across the tidal flow, consequently the berthing of vessels is invariably assisted by one or two tugs; the number depending on the size of vessel and on wind and tidal conditions. When proceeding to her berth, the tugs maintain a "broad-off" position at her bow and stern, made fast with short bow hawsers. The tugs are thus capable of swinging the vessel's bow or stern as required. On departure from the berth, a stern hawser from the tug's towing hook is the usual procedure.

Until June of last year the Board's fleet consisted of two twin screw steam tugs—"William C. Daldy" and "Te Awhina." The former was built in 1935 by Lobnitz & Co. Ltd., Renfrew, and has a static pull of 17 tons when developing about 1,300 I.H.P. "Te Awhina" was built in 1908 by Fleming and Ferguson Limited, Paisley, and has a static pull of 7¼ tons with 900 I.H.P. Both have coal fired scotch boilers.

In 1955 the Board decided to add a further tug to meet the increase in the size and number of vessels using this port and Sir J. H. Biles & Co., London, were engaged as the Naval Architects. In 1956 an order was placed with Fleming & Ferguson Ltd., Paisley, for a twin screw steam tug. She was named "Aucklander" and was launched in November, 1957. Trials were held on 10th and 11th March, 1958, and the delivery voyage commenced 27th March, with calls at the following ports: Port Said, Aden, Colombo, Singapore, Darwin, Townsville and Brisbane. She arrived in Auckland on 29th June, 1958. The accompanying photograph (Fig. 3) illustrates the "Aucklander" on arrival in Auckland.

Propulsion is by triple expansion surface condensing engines supplied by steam at 200 p.s.i. from two oil fired scotch boilers. The propellers are contained in nozzles supplied by the Kort Propulsion Co. Ltd., twin rudders, operated in tandem by Hylands-Vickers-Armstrong hydraulic steering gear, are mounted immediately abaft the Kort Nozzles.

A single stage centrifugal fire pump by the Pulsometer Engineering Co. driven by a Hayward-Tyler steam turbine with reduction gear, is fitted in the engine room. Capacity is 1,700 gals./min. at 1,400 r.p.m. against 280-ft. head. Two monitors, one on the flying bridge and one on the boat deck, are fitted in addition to a hose distribution chest on after deck. Provision is also made for foam discharge. Oil fuel is carried in deep tanks with a reserve double bottom tank in the engine room, total capacity 107 tons. Fresh water totalling 155 tons is carried in fore and after peaks and deep tanks.

On trials, a static pull of 28 tons was obtained at 120 r.p.m. developing 1,730 i.h.p. Max. speed obtained was 12.43 knots at 150 r.p.m. developing 2,061 i.h.p. Consumption 1.436/i.h.p./hour. Total cost £248,300 which, includes £10,300 for delivery to Auckland, New Zealand.

Fig. 4. View of a mess room showing facilities provided.

Port Workers' Amenities

In common with other ports of the world the Board has had to face the post-war demand for improved conditions and amenities for port workers in the two main groups, namely, the Board's own employees and the cargo workers or dockers as they are usually called in England. To cater for the latter group numbering some 2,000 men a Port Amenities Committee has been set

The Port of Auckland—continued

up. This consists of representatives of the Cargo Workers Union, the Port Employers Association and of the Board under the chairmanship of the Waterfront Industry Commission.

The Committee's task is to establish the location, extent and scope of the various amenities and then, through the National Amenities Committee, require the Board to provide them, the cost being recoverable from the commission.

The central or main amenity, known as the Port Building, is a three storey building currently being extended to provide a fourth storey and it provides lockers, ablutions, hot showers and toilet facilities for the full strength of the Union. It includes a cafeteria and kitchen for meals and tea making facilities for those men who prefer to bring their own meals. At the individual wharves there are snack bars, change rooms (usually without lockers) and toilets.

The standard of building work and furnishing put into these amenities is high and the confidence of the designers has been realised in that the workers have responded well and the amenities are treated with respect—the fears expressed by the Jonahs, based no doubt on a " keeping coals in the bath " outlook, have proved ill founded.

For the Board's employees a similar high standard has been introduced and maintained, the usual scale of provision being a mess room with cooking facilities, basins and showers with hot and cold water, toilets, clothes drying rooms and lockers. Lockers are in banks or groups, of wooden construction (5-ft. 6-in. high, 21-in. deep, 14-in. wide with a shelf and coat rail) set 15-in. clear of the floor, and, where space permits, with a bench seat in front. Wall linings vary from terrazzo, Formica, vitreous tiles to painted plaster depending on usage: floor coverings are p.v.c. tiles, linoleum or bituminous fabric; table tops are finished in Formica or linoleum; urinals are in tiles or stainless steel.

The floor area required for such amenities varies from 20 to 25 sq. ft. per man depending on the number of men and the scope of the amenity and the cost varies from £80 to £150 per man depending on the number of men, the scope of the amenity and the building conditions. The accompanying illustration (Fig. 4) shows a mess room with a small goods serving counter.

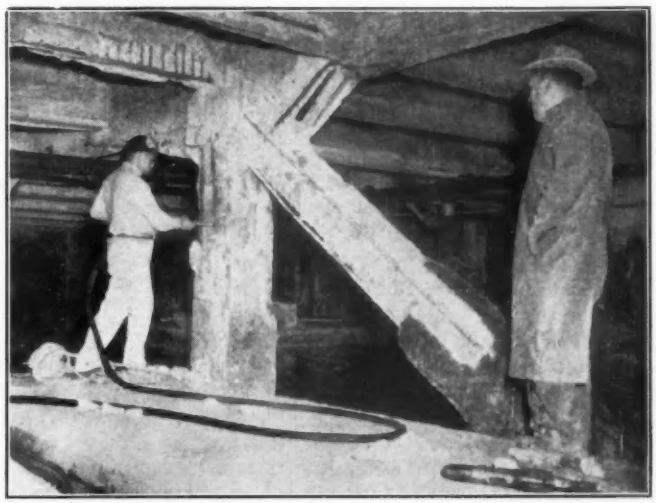


Fig. 6. Concrete wharf repair gang at work under Queens Wharf.

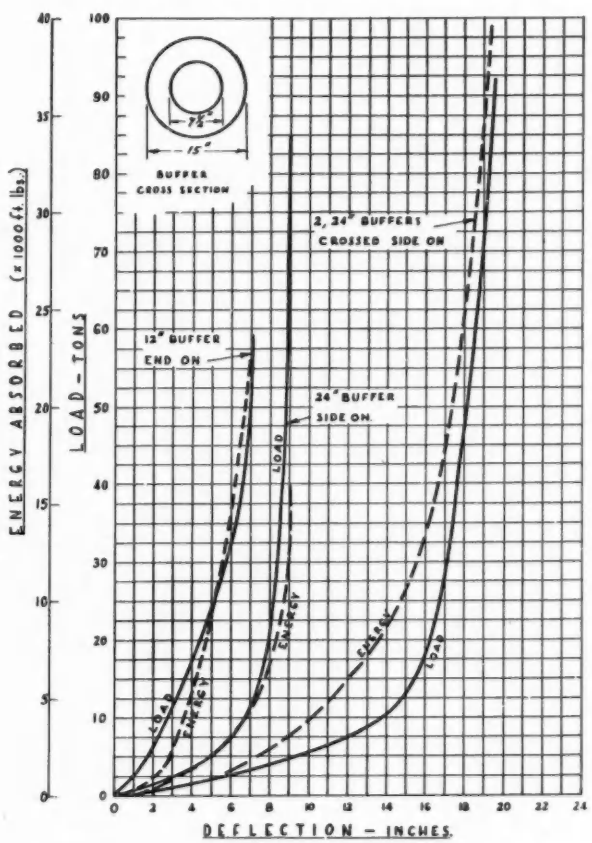

ENERGY ABSORBED (x 1000 ft. lbs.)
LOAD - TONS
DEFLECTION - INCHES
BUFFER CROSS SECTION
7½"
15"
2, 24" BUFFERS CROSSED SIDE ON
12" BUFFER END ON
24" BUFFER SIDE ON
LOAD
ENERGY
0 2 4 6 8 10 12 14 16 18 20 22 24
0 5 10 15 20 25 30 35 40
0 10 20 30 40 50 60 70 80 90 100

Fig. 5. Rubber buffer performance curves.

Rubber Buffers in Fender Systems

For many years it has been the practice in this port to provide cushions of rubber tyres between the hardwood fender pile system and the wharf structure but recently the purpose made rubber buffer has been adopted and there are now five such installations. All follow the principle of using rubber in compression which though not the most efficient, is the most popular because of ease of fixing. The structures are:—

(1) The bulk sugar berth at Chelsea Refinery.
(2) Passenger ferry wooden jetty at Chelsea.
(3) Training pier at Calliope Dock.
(4) Dolphin at passenger ferry berth Devonport.
(5) Protection for portal of Devonport Vehicular berth.

The size of rubber used in all cases is 15-in. x 7½-in. bore by either 12-in. or 24-in. long. The **methods of fixing** are as follows:—

(a) **Side on:** a single rubber 12-in. or 24-in. long compressed radially between the wharf cantilever face and the fender pile waling. The unit has a flat steel strap 2-in. x ¼-in. with rounded corners through the bore, the strap being held to the wharf with 2 bolts, all metal being galvanised.
(b) **Side on:** double rubbers each 24-in. long fixed as before, one to the wharf and one to the fender pile waling, crossed one on the other and compressed radially so giving a longer travel and twice the energy absorption for the same load as a single rubber.
(c) **End on:** a single rubber 12-in. long pressed on to a cast iron spigot which is bolted to the wharf and limits the travel to 50% of the buffers original length.

Gauges to measure deflection have been fixed at selected places and these have given some idea of the loads imposed on the structures. The gauges are steel flats attached to the fender piles and slide on a hardened steel pointer attached to the wharf. The pointer scratches the paint and so gives a permanent record of all deflections. The deflection of the rubber is easily related to the load imposed and the energy absorbed by means of graphs based on compression tests carried out by the Board. Three typical graphs are shown on the accompanying diagram (Fig. 5).

Failures: There have been some failures of the rubbers in the fender systems mainly because of over stressing. In one case a single rubber took 3 times its designed energy absorption in one blow and was so severely torn that it required replacing. It

The Port of Auckland—continued

justified its use, however, as the more costly fender pile outside it was uncrushed. Where no cushion of rubber is provided the wooden fender pile is liable to be severely crushed and its replacement is expensive.

Cost: Locally manufactured units are not extruded as are the common overseas ones but are rolled on a mandrel for curing. The makers are confident that no laminations will occur and so far their confidence has been justified.

The cost of these locally manufactured buffers is £20 for a 15-in. x 7½-in. bore unit 12-in. long and £30 for a similar unit 24-in. long. The cost of fixing is only two or three pounds per unit.

Repair and Maintenance of Concrete Wharves

The deterioration of reinforced concrete under wharves is a problem inherent in all such marine structures and a repair gang is constantly employed on the necessary repair work. Queens Wharf, which was built in 1906—1913, is now receiving its third repair, which is expected to take up to four years at a cost of £45,000. This wharf has an area of 7¾ acres with over 7,000 structural members which require inspection, and of which the majority will need to be repaired in some degree. Breaking out deteriorated concrete, cleaning reinforcement and re-concreting, all undertaken from floating plant in poor light, is slow work, but it is essential work, so as to ensure that the wharves have as long a working life as possible.

The method of working usually adopted is to break out the deteriorated concrete with pneumatic tools or hammer and chisel; clean the reinforcement with flame and wire brush; box up and place new concrete. Some years ago trial repairs were done with the cement gun process which appears to be quite satisfactory and some repair work using this process is now proceeding on a contract basis. The procedure adopted is to break out the deteriorated concrete as before; clean the reinforcing bars and concrete face by sandblasting; apply the new concrete with cement gun.

Fig. 6 illustrates breaking out work in progress and the exposed reinforcement may be clearly seen.

The Cleaning and Gas-freeing of Tankers

The following abstracts of two articles, by J. G. Armstrong and H. Deschenes respectively, decribe a land installation and a floating installation for the cleaning of Tankers and continue the series based on papers presented at the Third International Harbour Congress which was held in Antwerp in June, 1958, under the auspices of the Royal Flemish Institution of Engineers.

Land Installation at Falmouth

By J. G. ARMSTRONG

Introduction

Ten countries, including Great Britain, have now ratified the International Convention for the Prevention of Pollution of the Sea by Oil, which was drawn up in London in 1954 and which came into force on the 26th July 1958. The main effect is that ships registered in Convention countries are prohibited from discharging persistent oils—e.g., crude oil or fuel oil—within fifty miles from any coast, but a more extensive prohibited zone is specified for the protection of certain coastlines in Europe.

It follows that major repair and discharge ports will eventually assume responsibility to provide reception facilities for effluents such as contaminated ballast water, oily sludge and tank cleanings from tanker vessels as well as passenger and cargo vessels.

Cleaning Installation at Falmouth

It was decided in 1941 to construct and investigate at Falmouth what eventually came to be the first full scale land tank cleaning installation in the United Kingdom. This installation was brought into service in 1951. It is equipped with a Victor double-entry, multiweir, gravity-flow open-type separator capable of separating oily ballast water at a maximum rate of 1,000 tons per hour. The separated oil drains off into a drain tank from which it is pumped to either one of two receiving tanks. Oil-contaminated solids are dealt with by a Victor oil extractor, the oil being drained into a drain tank from which it is pumped to one of the above-mentioned receiving tanks. All drains from tanks are passed through a Duplex filter unit before being delivered to the separator.

The installation is furthermore equipped with a process tank for cleaning and dewatering the separated oil, and a recovered oil storage tank. All tanks are completely enclosed in an earth bund of sufficient height and area to accommodate the contents of the two largest tanks. The boiler house is built at a distance from the separator and tanks to suit the requirements of the Local Authorities. The pump house is adjacent to the separator.

The essential requirement of such an installation is the gas-freeing of a tanker in the shortest possible time prior to repairs or to the outward voyage to the oilfields. The speed with which this gas-freeing operation is carried out is dependent on a number of factors. At Falmouth, the shortest time achieved actually alongside the cleaning berth has been 4½ hours, and the longest 4½ days. Out of a hundred consecutive tankers which arrived for cleaning, 76 were cleaned in 24 hours or less. This is of considerable interest when compared with the former practice of proceeding out beyond the fifty-mile limit to clean and discharge dirty tank washings. This practice prolonged the voyage from the port of discharge to the repair port by anything up to 2½ days, followed on arrival at the latter port by further gas-freeing operations.

Cleaning Procedure

When a vessel has berthed at the installation, flexible hoses are connected to the shore pipelines, and the contents of sludge and ballast tanks are pumped ashore to the separator, using the vessel's own pumps. Victor Pyrate tank cleaning machines are connected and rigged in the cargo tanks, and the operation of tank cleaning is commenced. Washings are pumped ashore to the separator. In order to assist towards pumping tanks dry, the vessel is trimmed between 6 and 8-ft. by the stern; it is also listed to port or starboard to assist the vessel's stripping pumps. As the cleaning of each tank is completed, windsails or air-driven ventilating units are rigged to ventilate the tanks. Approximately five complete air changes are usually necessary to obtain gas-free conditions within the tank. On completion of tank cleaning, the pump room bilges are hand-hosed down with hot water and cleaned and the washings pumped ashore to the separator. When cleaning has been completed in all tanks and pump rooms, the operation of line washing is commenced, if necessary using hot water jets from the vessel's supply or from the installation. Each cargo tank, pump room and cofferdam space is then tested by a chemist for the presence of inflammable and toxic petroleum gases. If the results of the testing are satisfactory, certificates are issued to the effect that work can be carried out on board the vessel.

The issue of these gas-free certificates does not make allowance for "hot work," i.e. welding, burning, hot riveting or any work involving the use of naked lights. If "hot work" is required, the chemist is notified and the particular place together with surrounding spaces is thoroughly examined and tested. Should there be any loose scale or deposits in the vicinity or in the surrounding spaces, then these must be removed, using non-ferrous tools, and the structure thoroughly cleaned. At least once a day during the execution of work—whether "hot work" or otherwise—the spaces must be inspected by the chemist and the prevailing safety conditions verified to his satisfaction. While repairs are being carried out a current of air under forced draught is continuously circulated through the tank or space. In general, the ventilating unit should have a capacity of not less than 1,000 cu. ft of air per minute.

Cleaning and Gas-freeing of Tankers — continued

Tank Cleaning Machine

The Victor Pyrate tank cleaning machine is provided with slowly rotating hot-water nozzles (optimum working pressure 180 lb./in.^{2}, optimum temperature 180°F.). The rotary movement is produced by the flow of water turning an impeller. These machines are introduced into the vessel's tanks through special flange covered openings in the tank top, which are so sited that the machine is located in the best position for cleaning the tank surfaces. During the whole cleaning cycle of the cargo tanks using cleaning machines, the ship's pumps must be kept running in order to prevent any water-and-oil build-up on the bottom of the tank.

For the average-size tank of 1,000 tons capacity, two machines are sufficient for effecting the cleaning operation. For the first 40 minutes, the machine is positioned at a distance of 10-ft. from the tank bottom, and for the next 40 minutes at 10-ft. from the tank top; finally, for a third period of 40 minutes, it is positioned approximately at the centre of the tank. It is essential that as soon as cleaning is completed the tank be ventilated to ensure that the surfaces dry rapidly. This limits corrosion and speeds the gas-freeing operation.

Sludge and Solids Handling

The tank cleaning installation at Falmouth includes a vacuum solids-handling system. The equipment consists of a steam-driven reciprocating vacuum pump which exhausts the contents of two 10-ton capacity cylindrical vacuum tanks connected to a main line led to a convenient point adjacent to the vessel being cleaned and gas-freed. From a manifold at this point, four flexible hoses are led to the bottom of the vessel's cargo tanks. Each hose is equipped with a patented suction nozzle. Loose scale is removed with the aid of non-ferrous tools and conveyed by hand to within a convenient distance of the nozzle. An operator using the nozzle lifts the solids, which are then transferred to either of the 10-ton cylindrical tanks. They are thence discharged into a sludge tank to await treatment in the Victor oil extractor. With this equipment a 50-ft. suction head can be maintained.

Safety Precautions

An important feature in deciding the location of an installation is that of isolation. With a land tank cleaning installation of the kind described above, maximum safety can be achieved only by keeping all possible sources of ignition away from any point of emission of vapours. The recommended safe distance is about 100 metres. In the case of the Victor 1,000 ton/hour separator, hazard is minimised, as crude oil is present only as a thin film on the surface of the water in the separator bays. The oil is therefore at about the same temperature as the water, which will normally be below the flash-point of the oil. Water mist nozzles and services, forming an additional safety precaution, have been fitted to the separator.

A good guide to the practice of safety within a land tank cleaning installation is contained in the "Model Code of Safety Precautions in the Petroleum Industry" published by the Institute of Petroleum in Great Britain. To combat the hazard of static charges of electricity, all pipelines, tanks and equipment are earthed. As an additional safety precaution, inert gas is introduced above the contents of tanks in the bunded area. Cleanliness plays an important part. Oil spills, even of a minor nature, which take place within the installation should be immediately cleared away.

The labour force required to operate the plant during the whole of one operating time consists of one manager, one skilled mechanic and nine unskilled workmen. In the normal course of events maintenance of equipment together with cleaning operations within the installation are carried out by these men during times when the plant is not in operation. The oil recovered by processing from the sludge is more than sufficient to supply the needs of the installation.

The estimated cost for machinery and equipment for a typical land tank cleaning installation, as based on estimates obtained in the United Kingdom in January 1957, is approximately £120,000, exclusive of all civil engineering works and buildings, but inclusive of erection. The three main items comprised in this figure are in respect of boiler house equipment (£44,000), Victor separator and associated equipment (£22,000), and tankage (£31,000).

Floating Installation at Le Havre

By H. DESCHENES

Introduction

Large tankers have to discharge anything up to 20,000 tons of oil-contaminated ballast water. The reception installations for dealing with this discharge at ports should therefore either have sufficient tank capacity for temporarily storing such a quantity of water or, alternatively, be equipped with high-duty separators capable of effecting the continuous treatment of the contaminated water at a rate of at least 1,500 tons per hour.

Tankers carry their own equipment for cleaning and gas-freeing their tanks. In order to speed up these operations, however, this equipment is supplemented by that provided by the special cleaning and gas-freeing installation available at the port. In particular, the installation must provide rotary hot-water nozzles (tank cleaning machines) as well as the hot water under pressure needed to operate them. It must furthermore be equipped with high-duty ventilation plant, lighting equipment and pumping plant, and should preferably be of such capacity as to enable the gas-freeing of a tanker to be completed in one day.

If the vessel is to undergo repairs, it is necessary thoroughly to clean the tank affected, as well as the adjacent tanks. In this cleaning operation it is particularly essential to remove all rust scale and oil deposits. This calls for the use of mechanised equipment in conjunction with hand labour by operatives who fully understand the hazards of their work. It should be possible to effect the complete cleaning of a tanker (i.e., removal of scale and deposits, etc.) in about 40 hours.

Installation at Le Havre

The first tank cleaning installation in France has been put into service at Le Havre. It is operated by a private company, the Société Maritime de Dégazage.

The installation had to be capable not only of cleaning and gas-freeing tanker vessels, but also of cleaning the oil-fuel tanks of passenger and cargo vessels and of vessels undergoing repairs in dry docks. It was desirable to be able to treat liners at their normal berths and not to compel them to proceed to a central berth for treatment by a land tank cleaning installation. A further requirement was that it should be possible to deal with tankers at a special berth in the petroleum harbour or alternatively at a floating repair dock.

In view of the above requirements it was necessary to provide a mobile floating installation rather than a fixed land-based one. The present installation comprises a self-propelled vessel (length 43 m., beam 8.25 m., gross tonnage 410) and a large pontoon flush-deck barge, not self-propelled (length 64 m., beam 12.60 m.).

Self-propelled Floating Installation

The self-propelled floating tank cleaning installation is a converted coaster designated as the "S.M.D.1." It is equipped with four pressure-type conversion unit separators, for series or parallel operation, and capable of dealing with up to about 600 tons/hour. In addition, the vessel is fitted with equipment for supplying hot water to Victor Pyrate tank cleaning machines, together with vacuum pumps, patented vacuum suction nozzles and related tankage for removing bottom solids and sludge from tankers and from the double-bottom tanks of other vessels. Diesel-driven air compressors are installed for driving ventilating fans, lighting units and portable pumps on board the vessel being cleaned and gas-freed.

The "S.M.D.1" is placed alongside the vessel to be treated. The various flexible connecting hoses (vacuum hoses, hoses for hot water, steam and compressed air) are accommodated within

Cleaning and Gas-freeing of Tankers—continued

a hollow derrick-type jib attached to the rear mast of the "S.M.D.1." Several tanks can be treated simultaneously, the tanker's own cleaning equipment operating in conjunction with that of the floating installation. The contaminated water is pumped to the separator on board the latter craft. As soon as a tank has been cleaned with hot water, ventilating units driven by compressed air are put into operation in order to speed the gas-freeing procedure. When the air in the tank has been sufficiently purified in this way, a gang of men enters it in order to finish the cleaning operation. This involves the use of hand hoses and removal of the residual liquid and part of the solids by means of vacuum suction nozzles.

The "S.M.D.1" is fitted with a number of safety devices and with efficient fire-fighting appliances. Oily sludge and solids are handled by vacuum equipment, which eliminates the use of buckets and barrels with their attendant fire hazard. The sludge is conveyed directly from the tank being cleaned to the storage tank of the floating installation through armed rubber hoses.

Three portable compressed-air driven pumps are provided for discharging contaminated water (ballast water and/or washings) to the separator. These pumps are supplementary to the tanker's own pumping equipment. Compressed air is supplied by two compressors, each driven by a 150 h.p. diesel engine. Ventilation of the tanks is assisted by three portable induced-draught ventilating units, which are likewise driven by compressed air. The air extracted from the tanks is passed through canvas pipes and discharged at a safe distance from the vessel. Removal of solids and sludge is effected by means of two vacuum pumps through 4-in. diameter rubber hoses fitted with suction nozzles manipulated by hand. Each pump has a capacity of 40m³/minute, and the pneumatic handling equipment is capable of dealing with about 20 tons of sludge liquid per hour. These pumps are each driven by a 150 h.p. diesel engine.

The contaminated water is fed to separators in the floating installation; after removal of the oil, the clean water is discharged overboard. Depending on the degree of contamination, the separator equipment on board the "S.M.D.1" is capable of dealing with 200—600 tons of contaminated water per hour.

The solids and sludge are stored in special vented tanks. Gases are drawn off and discharged from the top of the forward mast. The floating installation is furthermore equipped with boiler plant consisting of two horizontal boilers for supplying the necessary hot water and steam. Three pumps deliver the hot water to the tank cleaning machines at a pressure of 14 kg/cm². These pumps are driven by 150 h.p. diesel engines.

Pontoon-type Auxiliary Installation and Land Installation

The "S.M.D.1" is too small a vessel to be able to deal with contaminated ballast water discharged at a continuous rate of between 1,000 and 2,000 tons/hour from large tankers. For this reason a second floating installation consisting of a pontoon-type barge, designated as the "S.M.D.2," has been provided. This installation, which is not self-propelled, is equipped with conversion unit separators which can treat up to 1,600 tons of contaminated water per hour. The two craft ("S.M.D.1" and "S.M.D.2") operating in conjunction are thus capable of dealing with ballast water discharged at a maximum rate of 2,200 tons/hour, which is adequate for coping with the discharge from the largest tankers. Even under the most unfavourable conditions, ballast-water discharging is completed within ten hours.

A small land tank cleaning installation has also been constructed at Le Havre. It is equipped with the appropriate tankage, a pump house, a boiler house, a small open-type separator, a Victor oil extractor, etc., and is conveniently sited so that the floating craft can discharge their contents to it from an adjacent quay. In addition, these craft can themselves be cleaned at this installation.

Amphibian Traffic in Germany

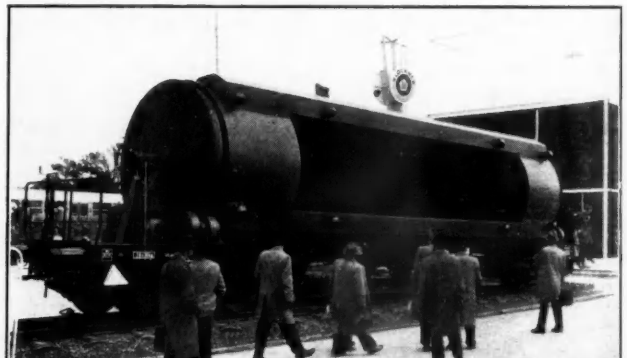
By JOHN GRINDROD, B.A.(Com.)

With a view to eliminating all complicated and unnecessary operations involved in the movement of bulk materials carried partly by water and partly by land, the possibilities of amphibian traffic have recently been studied in Germany and two interesting transport tubes or amphibian containers have been constructed. It is claimed that, by these new devices, transhipment between barge and rail or road transport, and the construction of costly harbour installations, can be avoided; transport facilities harmonised; and time, money and labour saved.

Begun when large shipping units were broken down into smaller and more convenient vessels which could be assembled to form rafts, the trend toward amphibian transport was carried a step further with the construction, several years ago, by Berg- und Hüttenbetriebe Salzgitter, of a transport tube raft which has been operating successfully since.

Although, due to prevailing circumstances, it has not been possible to carry out further developments of the loading and discharging facilities of this interesting means of transport, A.G. für Berg- und Hüttenbetriebe, at Salzgitter-Drütte and the Hoesch Werke A.G., at Dortmund, recently joined forces to form a working party known as Arbeitskreis Amphibischer Verkehr to study amphibian traffic with a view to finding a solution to the problems associated with this kind of traffic.

In their studies, this working party reviewed the existing means of transporting bulk materials. In the first place it was considered that the conventional methods employed by railways and inland waterways would have to be modified if they wished to hold their own in competition with the conveyor belt and the pipeline. Pioneers of transportation had repeatedly drawn attention to the fact that, though the individual means of transport and transhipment facilities had been developed to the highest possible levels, there was no co-ordination between them.



The transport tube developed by Famas-Linke-Hofmann-Busch G.m.b.H.

The study group found that the majority of traffic movements by waterway were preceded by transport on the road or by rail. Conspicuous within the framework of traffic rationalisation were the efforts made by the railways to save transhipment costs and/or costs of reloading from rail to road and vice versa. This was evidenced by the increasing use of containers and the trial runs of the railways with multi-purpose vehicles. But this rationalised transfer of goods was not found between rail and waterway. For instance, of the 23 important iron and steel works in the German Federal Republic no more than two of them unload their bulk material—in this case, the ore—direct from the boat into the blast furnace ore bunkers. All the others had to use "broken transport," conveying the material from the canal or harbour via intermediate distances to the blast furnace bunkers. Where such traffic was also "broken" in the despatching area, and this was found by the study group to be usually the case, transhipment costs for an annual delivery of two million tons of ore,

Amphibian Traffic in Germany—continued

which represents the requirements of an important metallurgical plant, could be as much as D.M. 5,600,000.

The study group concluded that, in order to eliminate these transhipment charges, amphibian traffic approached the ideal for bulk material transport. Moreover, the equipment required for such traffic would involve no high "fixed" costs such as is the case when costly harbour installations are built. Such "variable costs" as are involved arise only proportionately with the traffic handled and are not lost when sources of supply or traffic routes are changed.

Amphibian Vehicle, constructed by Orenstein-Koppel and Lübecker Maschinenbau A.G., floating in the water prior to being placed on railway bogies.

In view of the rapid development of industry, the group considered that any possible changes in the streams of traffic and in the kind, quantity and destination of the goods must be taken into account. For instance the coal and iron industry might develop new smelting, refining, coking or other manufacturing processes which could have a very considerable influence on the tonnages handled. In such a case, amphibian traffic could serve as a link between the three main transport media — water, rail and road.

Two amphibian containers were therefore constructed, one by Famas-Linke-Hofmann-Busch G.m.b.H. and the other by Orenstein-Koppel and Lübecker Maschinenbau A.G. In addition, an installation was devised for landing the containers or placing them into the water or on bogies for conveyance by rail.

Designed on the lines of the conventional Westphal transport tube, the container developed by Famas-Linke-Hofmann-Busch G.m.b.H., Salzgitter, was constructed as an automatically trimming tubular vessel with a top discharging opening 1.8 metres in width. For rail transport it has been reduced to half the length of the Westphal tube, that is, to 12 metres. It also differs from the latter in that the end bulkheads are developed as bearing rings, by which the tube is placed on transport bogies and turned by a mechanical drive for emptying. The bulkheads are also arranged on the slant to facilitate the discharge of the load.

The container has a capacity of 65 cu. metres and a total weight of 80 tons when loaded. Given a deadweight of some 30 tons, including transport bogies, a useful load of 50 tons can be moved. The tube is designed as a rigid structure and is fitted with a flat bottom inside which permits the cargo also to be unloaded by means of a grab. The overall design ensures freedom of movement by water to any landing point, even though it has no transhipment facilities for transferring the cargo to railway wagons.

Fitted on both transport bogies, the discharge equipment consists of an electric drive, over a gearing which gives an emptying speed of one semi-revolution per minute. Power transmission is effected by drive rollers, arranged sidewise, which link up with bearing rings of the end bulkheads.

Symmetrical and safe support of the tube is achieved through its prismatic mounting which is controlled from the operator's stand on one of the bogies. When travelling by rail a maximum buffer pressure of 200 tons is available for transmitting tractive forces. A bolting device in the middle of the tube, which need not be released when emptying the cargo, secures it against displacement in case of buffer shock or a derailment.

The capacity of the driving motors is so rated that, even in the case of unfavourable loading with material of high specific gravity, such as ore, an adequate torque is available. The tube can be unloaded from either side as required, the bulk of the cargo being discharged sideways and the rest between the rails at a turn of 180 deg. The tube also possesses adequate floating stability even when travelling empty.

In their construction of an amphibian vehicle, Orenstein-Koppel and Lübecker Maschinenbau A.G., aimed at producing a floating container for bulk materials adapted to the majority of existing bunkers and capable of simultaneous discharge on both sides of the trackway. To this end, the transport tube was divided longitudinally into two similar containers rigidly connected with each other by simple couplings to form a single tube with good floating properties. When lifted out of the water the tube is placed with each end resting on a supporting frame which is mounted on a two-axle bogie. The tube is then firmly fastened to the supporting frame by means of four spindles so that it forms a whole unit with the bogie and is capable of absorbing or transmitting the tractive and impulsive forces as prescribed by the German Federal Railways, buffers and draw gear being arranged at the ends of the supporting frames.

On arrival at the harbour, the vehicle is landed by the special device described later and sent by rail to the consignee where the four spindles and the tube coupling are unscrewed by hand. Held in an arresting device, the tube then stands ready for unloading. When the arresting device is unlocked by the pressure of a lever, the two halves of the tube move apart and by completing an arc over the bearing surfaces installed for this unloading operation, discharge simultaneously on both sides of the railway track into the bunkers.

In the unloading position, the side wall, which serves as a chute, has an inclination of 60 deg., so that even difficult material will slide down while the tube is held in position by a Norwegian hook. On the release of the hook, each half of the tube rolls back again automatically. With a light pressure of a lever they are again coupled and spindled up with the supporting frames. After discharge, the vehicle can be returned by rail to the harbour either singly or in convoy. Unloading is entirely by gravity and is effected without the use of any mechanical aids.

The following are the dimensions, weight and capacity of the Orenstein-Koppel amphibian vehicles:

Weight of transport tube	15 tons
Carrying capacity	51 tons
Weight of truck	29 tons
Gross weight	80 tons
Axle pressure	20 tons
Length of transport tube	12 m.
Length over buffer	16.7 m.
Bogie clearance	11.86 m.
Width of truck	3.05 m.

Developed by Maschinenfabrik Deutschland A.G., Dortmund, the landing installation includes a support running down from the railway line to an appropriate level in the harbour or canal, on which a trackway is laid. The latter is designed so that it can take both types of containers, and, with the aid of a built-in hoist on the bank, it is drawn up the bank to the top of the slope, where the tubes can be lifted and lowered on to the railway bogies by hydraulic lifting gear fitted to the landing truck. The truck is then withdrawn so that the tube can be moved on its special bogies in the same way as a normal railway truck. It is estimated that a floating container with a useful load of 50 tons can be landed every eight to ten minutes by this installation which costs only a fraction of the more conventional forms of transhipment such as transporter bridges, grab cranes, etc. Furthermore, the material does not have to be handled, which is of considerable importance for the more sensitive materials such as coke, which might lose up to 5 per cent of its value through transhipment by grabs.

Liverpool Observatory and Tidal Institute

Abstracts from Report for 1958

Storm-Surges

In spite of staff difficulties, considerable progress has been made in research work in storm-surges and reports have again been made on two occasions to the Advisory Committee on Oceanographical and Meteorological Research.

For the North Sea area attention has been concentrated on the disturbed period of December 11 to 30, 1954, and the question of interaction between tide and surge in the Thames. The results of the first of these two items are given in Mr. Rossiter's paper on "Storm-Surges in the North Sea, 11 to 30 December, 1954." This is an investigation into the mechanism of various disturbances in the North Sea during the period stated, the most outstanding being the double surge studied both in Holland and Germany. Co-disturbance lines have been drawn for the whole area for certain sequence of hours, and light has been thrown upon certain relevant facts. The effect of westerly winds upon levels in the North Sea has been examined, and a good example of a return surge discussed. Transverse water gradients due to the earth's rotation have been shown to be of great importance, much greater than those which could be attributed to any oscillatory motion in this body of water. The observational data have provided estimates of the frictional coefficients for both the air/sea and sea/ bottom interfaces, electrical cable measurements in the Straits of Dover area having proved especially useful.

Using a method devised by the Director in 1956 Mr. Rossiter has attempted to use a mathematical model of the Thames to explain the tendency for storm surges in the Thames to reach their maximum at a certain state of tide. The difficulties met with arise from the existence of large frictional terms in the computations, but it is expected that further work on this subject will prove profitable.

Work on west coast surges has taken the form of an investigation of the frequency of occurrence of abnormal levels at a number of ports. The significant feature of the problem here is that at a time of disturbance, both the tide and the surge contribution to sea level are changing very rapidly so that both must be known with precision before the combined effect is capable of definition with sufficient accuracy to enable a warning system similar to that now in operation for the east coast to be possible. In view of the special difficulty of forecasting storm surges effects here, the general effectiveness of the coastal defences assumes a greater importance and the establishment of a frequency law for the occurrence of abnormally high levels is of special interest to the authorities concerned.

Preliminary attempts have been made to establish a frequency law using least-squares principles to fit a simple linear logarithmic function to the data available.

Mr. Lennon is continuing with this work and although severe limitations are encountered due to the short duration of the tidal records available, it is hoped that a more comprehensive study of the frequency laws will be possible.

Professor Proudman has published a paper on tides and surges in an estuary which deals theoretically with their propagation in an infinitely long estuary of uniform cross-section. Frictional terms have been neglected, and explicit formulae for the surface elevation and current are found in the form of infinite series.

The method of extracting storm surge residuals from hourly records of tidal height, as developed at the Institute during recent years, has been accepted for publication.

Mean Sea Level

Mean sea level is becoming a subject of very great interest, partly because of the very slow rise in mean sea level all over the world and partly because of proposals to utilise tide gauges fully in assisting the correlation of levelling networks in various countries. It was mentioned last year that a proposal had been made for the formation of a Permanent Service sponsored by the International Association of Oceanography and the Union of Geodesy and Geophysics.

One of the objects of such a Service will be the collection and dissemination of the data obtained in the International Geophysical year. The International Council of Scientific Union has now accepted the proposals and the Permanent Service will be carried on by the staff of the Tidal Institute. Its activities will be subject to a committee, of which the Director is Chairman and Mr. Rossiter is Secretary. Other members are:—

M. L. Cahierre, Institute Géographique, Paris.
Mr. L. P. Disney, U.S. Coast and Geodetic Survey, Washington.
Rear Admiral W. Knox, International Hydrographic Bureau, Monaco.
Dr. E. Lisitzin, Havsforskningsinstitutet, Helsinki.
Miss J. Patullo,, Scripps Institute, La Jolla.
Dr. J. van Veen, Rijkswaterstaat, Den Haag.

It is in connection with this work that Mr. Rossiter's paper concerning methods of extracting monthly and annual values of mean water levels has been prepared and published.

The mean sea level data for 1952 to 1956 has now been published.

On a national basis, a sub-committee has been formed by the Committee for Oceanographical and Meteorological Research to deal with mean sea level matters as they affect Great Britain. Mr. Rossiter is a member of this committee, and reports that many valuable steps have already been taken to ensure the increased quantity and quality of mean sea level data for the British Isles. The bulk of the computational work in this connection will be done at the Tidal Institute.

Northumberland Strait

During the summer the Institute was requested to investigate the effects of a permanent barrier between Nova Scotia and Prince Edward Island. This has involved considerable research by the Director and Mr. Rossiter, as to the methods of calculation suitable to a long strait. Satisfactory methods were adopted which incorporated frictional effects and results showed that the tides in the Strait would be very greatly affected, one curious result being that high water would occur on one side of the barrier when it was approximately low water on the other. Ranges of tide were somewhat increased. Considerable attention was paid to the effects of the barrier in the main Gulf of St. Lawrence, as the tides in the Strait are, of course, generated by the tides at the two ends of the Strait.

Proposed Thames Barrier

Considerable attention has been paid to attempts which have been made by engineering firms to calculate what the effects of a Thames Barrier would be. Advice has also been given to the Hydraulics Research Organisation in connection with investigations by their staff. This problem is one of great difficulty, because it is not easily possible to forecast what the effects of the barrier would be on tides at the entrance. The problem is not unlike that studied for the Northumberland Strait.

Earth Tides

Mr. Lennon has continued the observations which have been undertaken for the Earth Tide Programme of the International Geophysical Year. The three instruments of horizontal pendulum type used for this work have functioned satisfactorily and when the reduction of the data is complete, it is hoped that valuable information will be provided for the investigation of the earth's elasticity together with a further definition of characteristic movements of a regional and local nature. The general experience of workers in this field is that long periods of records are necessary before the true earth tide movements can be satisfactorily identified with precision and in this respect the impressive record of the Bidston instruments covering both components of tilt is becoming of considerable significance and is practically unique.

In July the Institute was pleased to welcome Mr. E. Kraut and Dr. C. Harrison of the University of California who installed in the building two La Coste-Romberg gravimeters for a short period so that the vertical movements associated with earth tides could be measured directly. This operation was in connection with the contribution of the U.S. Navy to the International Geophysical Year Programme, and each of the instruments had made an extensive circuit of stations through the preceding months,

Liverpool Observatory—continued

covering between them a representative selection of stations both continental and oceanic throughout the world.

The analysis of data from the Bidston instruments is proceeding and, in addition, the reduction of observations taken at Winsford has been completed. The Winsford station has now been taken over by the Department of Geodesy and Geophysics of Cambridge University which has called upon the Institute's services in the interpretation and reduction of the records.

On a number of occasions the Institute has been requested to review the techniques developed in this connection elsewhere and considerable interest has been shown in further refinements of the established procedure which has been evolved here.

Meteorological information has again been in great demand for a variety of reasons, both industrial and legal. The Tidal Institute has always been most anxious to maintain close contact with Hydrographic and Harbour authorities throughout the world, and is at any time willing to undertake investigations on their behalf.

Future Developments of British Inland Waterways

Government Proposals following the Report of the Committee of Inquiry

The Government have published a White Paper[1] outlining their proposals, following the publication of the Report of the Committee of Enquiry into Inland Waterways, set up under the Chairmanship of Mr. Leslie Bowes. The Bowes Report[2] contained, after a full survey of the problem, a number of far-reaching proposals. These included one emphasising the principle that the surplus on those waterways now operating profitably should be ploughed back and should not be dissipated in meeting deficits upon other waterways. For those waterways, which carry some traffic but on which revenue does not equal expenditure, the Report recommended "pump-priming" in the form of capital investment on improvements, a subsidy meanwhile, the substitution of an annual license for tolls (as advocated in these columns) and a guaranteed life of 25 years to create confidence amongst users. Finally for those waterways for which there was no hope of traffic revival, plans are suggested for Redevelopment procedure.

On all these points the Committee was unanimous, but on the method of reviewing waterways due for redevelopment and on the whole future administration of waterways the Committee was divided. The Chairman and three members advocated continued control of the navigable system by the British Transport Commission, with a new Redevelopment Board for the reviews of disused canals. Four other members preferred to see all the waterways transferred to a new body, which would be responsible for operation and for reviews; this alternative view was apparently advocated on the presumption that the Transport Commission could not be expected to adopt the best policy towards waterways, in view of its preponderant rail and road interests. The disturbance of the change envisaged in the establishment of a new Inland Waterways Corporation, operating under subsidy, might easily prove unjustified by any benefits arising.

In the White Paper, of which selected extracts are printed below, the Government shows that it is not ready yet to accept the unanimous proposals of the report in full; it also indicates reluctance to accept the alternative for a new Corporation.

Main Features of the Report

"The Report provides a valuable review of the whole problem, and contains important new recommendations. It throws into sharp relief the variety and complexity of the problems which inland waterways present, it brings out clearly the multiplicity of their uses, and it emphasises that to consider the waterway system solely as part of our inland transport network leaves much out of the picture. Moreover, the Report offers prospects of giving a fresh lease of useful life to much of the waterways system by adapting it to new circumstances, radically different from the days of its transport prime.

"The Report divided the nationalised waterways of England and Wales into three classes:

Class A. These are mainly the big barge navigations such as the River Severn or the Aire and Calder; taken together, they work at a profit.

Class B. These are mainly narrow-boat canals, generally with locks to take only boats 7 feet wide. They carry commercial traffic in widely varying degrees; very few of them pay their way, and taken together they are worked at a steady and substantial loss. The Committee saw no prospect that their receipts will suffice to meet charges.

Class C. These waterways the Committee considered to have no further value as commercial navigations; many are derelict, or semi-derelict.

"The Report recommended that capital development should be concentrated on the Class A waterways. The Class B waterways should be reinstated to prescribed standards, and so maintained, Class A and Class B waterways together constituting a national system whose availability for commercial navigation should be guaranteed for 25 years. The cost of restoring the Class B waterways, and their working losses, should be borne on public funds. Steps should be taken to enable potential revenue from uses other than commercial transport to be realised and these uses to be developed.

"A new approach to the problem of the Class C waterways by redevelopment was recommended, with a case-by-case review to determine to what use each waterway (or its site) can best be put and by whom it should be owned and managed, and to formulate detailed schemes for putting redevelopment into effect. A basic element in these proposals is that all the interests concerned in the redevelopment of these waterways should be brought into consultation, their full co-operation sought and appropriate financial contributions obtained from those who will enjoy facilities or amenities provided by the redeveloped waterway, or from its elimination, as well as from those who are relieved of liabilities."

The Government recognise that to implement some of the proposals legislation would be needed and therefore advocates interim proposals of an experimental nature to cover a period of possibly some two years.

Redevelopment

"A major part of the Committee's recommendations concerned the treatment of the Class C waterways, those whose usefulness for commercial transport has dwindled low or disappeared, but which are still socially valuable for drainage, water supply, recreation or amenity. In their recommendations, the Committee broke away from the negative concept of abandonment, suggesting instead the new and positive approach by redevelopment; redevelopment would either keep the waterway in being to serve primarily purposes other than commercial transport and might transfer responsibility for its maintenance and management from its present owners, or would eliminate it, bringing the waterway to an end as an entity and making available its site and works for whatever purposes they can best serve; different treatment might be found expedient for different sections of a waterway. The Government regard it as most desirable that early action should be taken to deal with these canals, and they endorse the objectives set out in this part of the Report. They consider that the general lines of the approach which it proposes are most promising, and should be tried out in advance of legislation. It will encourage and help in the ways set out below. The experience of this trial period, and the success with which it proves possible to redevelop canals disused by transport, will influence the shape of the permanent legislation which can be introduced later. The Government regard this as a necessary first step in dealing with the canal problem.

"To help in this process the Government will, in the first place, set up at once an Inland Waterways Redevelopment Advisory Committee to assist in the promotion of schemes, to consider schemes when they are formulated, and to make recommendations on them to the Ministers concerned. The Committee will also be invited to advise Ministers on any general matters connected with the redevelopment of inland waterways. The Committee will consist of members knowledgeable about the various interests concerned with redevelopment, including local author-

[1] Cmnd. 676, Feb. 1959; 6d., H.M.S.O.
[2] Cmnd. 486, July 1958; 6s. 6d., H.M.S.O.

Future Developments of British Inland Waterways—continued

ities, boat users, boat operators, industry, farming, land drainage, water supply and others.

" Secondly, on the financial side, the Government will expect that the cost of redevelopment will be borne by those who benefit from it, and any general legislation introduced later will be framed on this basis. This is consistent with the findings of the Report. Where beneficiaries are not now paying a fair economic price for the services they receive, the Government will look to see full payment made in the future, as the Report recommends, and will regard sympathetically proposals to obtain any necessary powers. If work proposed to be done in carrying out redevelopment schemes is eligible for Government grant under existing legislation, applications will be sympathetically considered. The Government's object will be to make those waterways which are kept in being for the sake of their " alien " uses (to use the Report's term) as nearly as possible self-supporting. But it is realised that in some cases a redevelopment scheme may serve a diversity of functions and that the cost cannot be entirely matched by payments from the interests concerned. Where this can be shown to be the case, the Government would be prepared in principle to bridge a small gap by a special ad hoc grant towards the capital cost of redevelopment. This will be a quite new measure of assistance, and it is intended to seek the necessary Parliamentary authority as soon as possible, without waiting for general legislation."

Putting Redevelopment Schemes into Effect

" The Report opens up a prospect of fresh action on canals and it is the Government's aim in initiating these proposals to make it possible for all those concerned to make a start in a new atmosphere, first in the field of redevelopment. Local authorities, among others, are asked to consider the part they can play. Canals can be redeveloped for amenity and recreation, and particularly in urban areas the sites of derelict canals can be reclaimed for other uses. It is also important that voluntary organisations (including those who use the waterways for angling or other recreations), which have shown so much interest in seeing canals preserved and restored, should take the opportunities for joint effort and contribution which the preparation of schemes will offer. The Government welcome the active interest which the National Trust are showing in the possibility of taking over and preserving for the nation lengths of waterway of particular beauty or historical interest and hope to see suitable waterways pass into the Trust's hands. The National Trust are now engaged in exploratory talks with the British Transport Commission. The initiative of the Trust, who are well-placed to focus voluntary interest and financial support and have much experience in management, would give a valuable impetus to the promotion of schemes. Attention has been drawn to certain structures of historic and architectural interest which were built as part of the old canal undertakings, and the Minister of Works is considering whether any of these can be brought within the scope of the Ancient Monuments Acts."

Future Administration and Programme

" As regards the waterways which are retained for commercial navigation, the Government accept the Committee's recommendations that the main effort should be directed to the development of those which the Committee put in Class A and which are able to earn their keep as commercial navigations (though the selection listed in the Report is not necessarily a final one).

" There is general agreement about the Committee's approach to redevelopment, and about its recommendations for the Class A canals. Some of the other recommendations of the Report, however, are more debatable. The future administration of the canals is a question on which the Committee themselves were divided. The Government have given careful consideration to the Alternative Recommendations for the setting up of an Inland Waterways Corporation. This would require legislation, and would place charges upon public funds. The Government propose to leave this question open for further consideration during the experimental period. In the meantime, the Commission have informed the Government that in the light of the Report, they intend to strengthen their Waterways Sub-Committee by enlarging it to take in members of the kind proposed by the Committee.

" The Government have also considered very carefully the Committee's recommendations for the Class B canals, the group of waterways which, while unable to earn their keep, still have some usefulness for commercial transport of merchandise. These recommendations raise issues on which the balance of national advantage is arguable. The Class B waterways are nearly all narrow-boat canals. Some of them have very little commercial use, and the Committee frankly record that they can see no prospect that this group, taken together, could in the foreseeable future earn sufficient revenue to cover their working expenses. To put these canals fully into condition and to cover their operating losses as the Committee contemplate, would place very considerable burdens upon public funds, much of it in the nature of a direct subsidy. The Government feel that during the experimental period, it would not be justifiable to do this. Thus a guarantee of continued availability for commercial navigation for twenty-five years of the whole 900 miles of these waterways cannot be given at this stage although every effort will be made to preserve the system as far as is practicably possible.

" The Report points out that these waterways have various uses besides transport, some of which produce revenue, and in some cases could produce more; not all these non-transport uses are reflected by a commensurate contribution to the waterways' upkeep, and the interim period will provide an opportunity to see how far these possibilities can be developed, It will also be possible for the Commission, or for any other bodies interested, in the case of individual waterways in this group carrying small quantities of commercial traffic, to propose schemes for their redevelopment. Such proposals would be subject to examination by the Advisory Committee and canals dealt with in this way would be eligible for consideration for the measures of Government assistance outlined above.

" The Government hope that experience of the development of these possibilities during the experimental period will show more clearly which of these waterways have real prospects of being made financially self-supporting, and how far the services, besides navigation, which they provide can be made to yield an economic return. During this period, the Commission will maintain these waterways at least in their present condition, and will, where traffic justifies it, undertake piling and other works of improvement. The Commission also intend to put in hand, as recommended in the Report, detailed engineering and economic surveys to assess the prospective value of making the Grand Union Canal navigable by wide barges without trans-shipment between Birmingham and the Port of London, and of a new broad waterway linking the Weaver with Wolverhampton. The Government propose to review the future of the waterways in Class B at the end of the period.

" The recommendations concerning the Caledonian and Crinan Canals and the main line of the Forth and Clyde Canal raise important issues, and are being further considered by the Government."

Improvements to Avonmouth Oil Basin

Bristol City Council has under consideration a scheme to improve the oil basin at the Royal Edward Dock, Avonmouth. The plan which is expected to take more than three years to complete, will include the provision of an extra deep-water tanker berth—the fifth at the oil basin—the complete reorganisation of the oil pipeline system in the dock, and the protection of the banks of the basin.

It was reported in 1955 that due to serious erosion of the banks, quay construction work would be necessary to prevent further damage. The council then approved an application to borrow £383,000 for this work, but the new scheme will mean an application to amend the borrowing powers to pay for the revised plan, the cost of which is estimated to be more than £1½ million. It is anticipated that the project will be started later this year, and that the revenue from the increased trade will more than cover annual charges.

Mechanical Marshalling of Railway Wagons

Review of Modern Methods Employed*

By G. W. GROSSMITH, M.C., M.I.Mech.E.
(Managing Director, Strachan & Henshaw Ltd., Bristol)

The methods employed for the movement of railway wagons in works' sidings have changed very little in 50 years, probably because appliances lending themselves to mechanisation were not available. Locomotives, capstans and winches are unsuitable for combination under centralised or automatic control owing to their need for men on the locomotives and also on the sidings to handle towing ropes and to work the wagon brakes. Free-running gradients have, owing to the greatly varying running characteristics of wagons, been too uncertain to give sufficiently consistent results.

In recent years a number of new appliances for the remote propulsion, braking and general control of wagon movements have been developed, suitable for employment separately or in combination according to the needs of the problem. The new devices may be broadly classified as mules, track brakes, arresters, traversers, and remotely controlled locomotives.

The development of these devices has made possible and, in fact, has brought about new techniques and simpler systems of sidings layout, with economy in cost and great economy in space occupied.

As far as servicing docks is concerned, however, the normal quayside arrangement in Great Britain is still to provide one or more tracks with hydraulic or electric capstans alongside, the wagons being served by a series of quayside cranes. At least one shunting loopline with appropriate cross-overs to the pay-load tracks has also to be provided as a necessary concomitant to this system of working. A locomotive delivers rakes of wagons at an approach to the crane-side tracks, the wagons are then manually uncoupled and hauled forward individually by the use of capstans and fairleads for "spotting" alongside the quay cranes. After loading or unloading by the cranes, the wagons continue forward by individual handling until sufficient are accumulated beyond a convenient turnout, when the rake is re-coupled and removed over the shunting looplines by locomotive. This operation becomes complicated when the quay has a number of cranes working but, on the whole, works satisfactorily where time is not an important factor and where the stevedoring gangs are both skilful and safety-minded.

THIS paper deals with the progress made in the last 10 years in the mechanical handling approach to the problem of wagon marshalling and with the range of equipment now available, and becoming available, for its solution. Rarely are two problems alike, and frequently a specially obstinate problem results in the development of something which turns out to be useful in other cases as they come along.

The term "wagon marshalling" as used here will mean the holding, forwarding, backing, braking, arresting, and traversing of wagons, entirely by remote or automatic control of suitable devices, in any chosen combination or sequence and without objectionable impacts, the wagon brakes being in the off position throughout.

Within this definition, it is not proposed to deal with capstans, winches, and incline haulages, not only because they are already well known, having been developed in an earlier era, but also because they have played no significant part in the development of wagon marshalling in its present comprehensive form.

Most of the appliances and devices described have been submitted to, and approved by, the Wagon Handling Appliances Committee of British Railways for use with their rolling stock, subject to limiting considerations in certain cases.

PROPULSIVE CONTROL: MULES, CHARGERS, PUSHERS, REMOTELY CONTROLLED LOCOMOTIVES

Mules

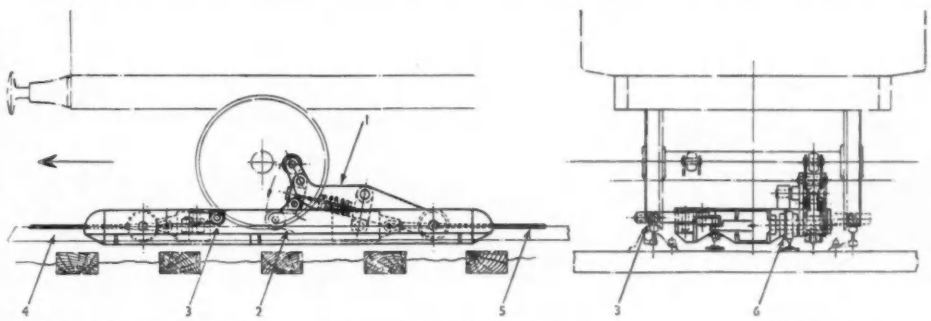
There would appear to be only four places, on the general run of wagons, at which a considerable propulsive force can be applied, these being the buffers, the coupling, the axles, and the treads of the wheels. So far as remote control is concerned, attention was first directed to propulsion by engagement with axles by means of retractable projections, or arms, fitted with rollers for contacting the axle and fixed to a carriage running on a pair of rails laid between the main rails, and a later development substituted wheel tread rollers to check forward movement and for backing, axle rollers being retained for forward propulsion. Such a carriage is propelled along its rails by main and tail haulage, the axle engaging arms being actuated by varying the tension in the haulage ropes. An increase in tension, operated by a separate motor, brings out the backing rollers, and the further tension set up when these rollers contact the wheel treads causes a relay to actuate the separate motor and still further increase the tension, which causes the axle engaging arms to rise The mule will then propel the wagon in either direction.

Axle mules can safely exert a propelling force of 5 tons, which might propel, on the level, a train of 500 tons gross weight.

British Railways permit the use of axle mules with their wagons with certain reservations, which include a maximum permitted propulsive force of 5 tons, a maximum permitted engagement speed of 50-ft/min., and a maximum permitted gradient of 1 in 40.

Wheel Tread Mules

To avoid the need for registering a mule, before engagement, with any particular part of the wagon, the wheel tread mule was designed, Fig. 2. This also takes the form of a carriage moving on an auxiliary pair of narrower gauge rails but has roller arms which protrude when the carriage is drawn forward, the whole mule then moving along the rail until the rollers make contact with the treads of the wagon wheels. The mule is mounted on skids, not wheels, so as to provide some resistance to movement, this resistance being used to provide the reaction which allows the tension in the haulage rope to actuate the toothed spline and so rotate the toothed quadrants until the rollers are in the wheel tread path, and, conversely, the tension in the tail rope, on reversal, to actuate and retract the roller

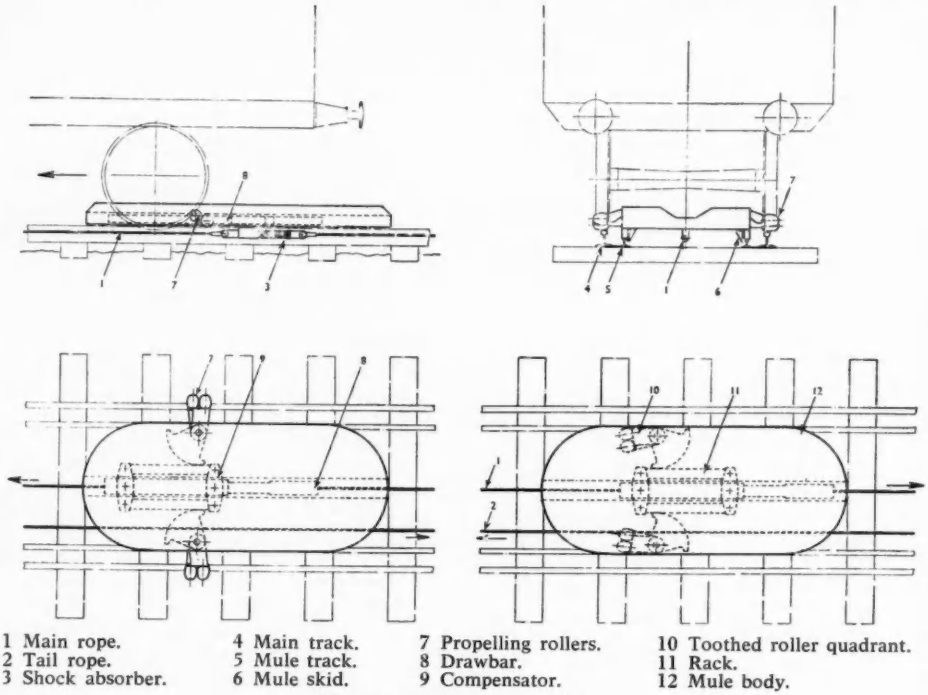


1 Engaging arm (extended).
2 Engaging arm (retracted).
3 Location and control rollers.
4 Main rope.
5 Tail rope.
6 Mule runners.

Fig. 1. Axle mules.

*Abstracts from a Paper published by the Institution of Mechanical Engineers, 1958.

Mechanical Marshalling of Railway Wagons – continued



1 Main rope.
2 Tail rope.
3 Shock absorber.
4 Main track.
5 Mule track.
6 Mule skid.
7 Propelling rollers.
8 Drawbar.
9 Compensator.
10 Toothed roller quadrant.
11 Rack.
12 Mule body.

Fig. 2. Wheel tread mules.

arms. The winch can therefore be driven by a simple reversing motor.

With this type of mule, axle spotting is not necessary, as the roller arms skid past the inner face of a wheel if they happen to protrude whilst passing it, after which they immediately open out and engage with the next wheel. Cross-compensation is incorporated, so equalizing the contact pressure under all conditions, including operation on curves down to about 5 chains radius.

This type of mule also is suitable for a tractive force of 5 tons, or more, with loaded wagons, though less with empty wagons owing to the lifting component of the inclined resultant of the pressure between roller and wheel.

By means of the mules, wagons can be detached singly, or in any desired number, from a rake standing buffer to buffer.

The forward speed of mules is normally about 50-ft./min., which is generally fast enough for the duty and does not produce jerky wagon movements. Even at that speed precautions must be taken against shock loads on the mule and its haulage ropes, and so the rope attachment to the mule is usually sprung. Further protection may be provided by a hydraulic coupling between the driving motor and the winch.

For moderate throughputs, the return speed may be the same as the forward speed, but for high capacities a fast return is necessary. This is accomplished either by equipping the winch with two motors, or a single motor and epicyclic gearbox with electrically operated brake, or, as in one recent development, a purely mechanical gearbox, in which the input and output shafts are co-axial. If the input shaft, motor driven, is revolved in one direction the output shaft revolves in that same direction at 1 to 1, but if the input shaft rotation is reversed, the output shaft, as well as also running in the reverse direction, does so at any selected different ratio, say, for a mule, 4 to 1. This self-contained mechanically automatic self-changing reversing gearbox could very well be useful in other haulage problems.

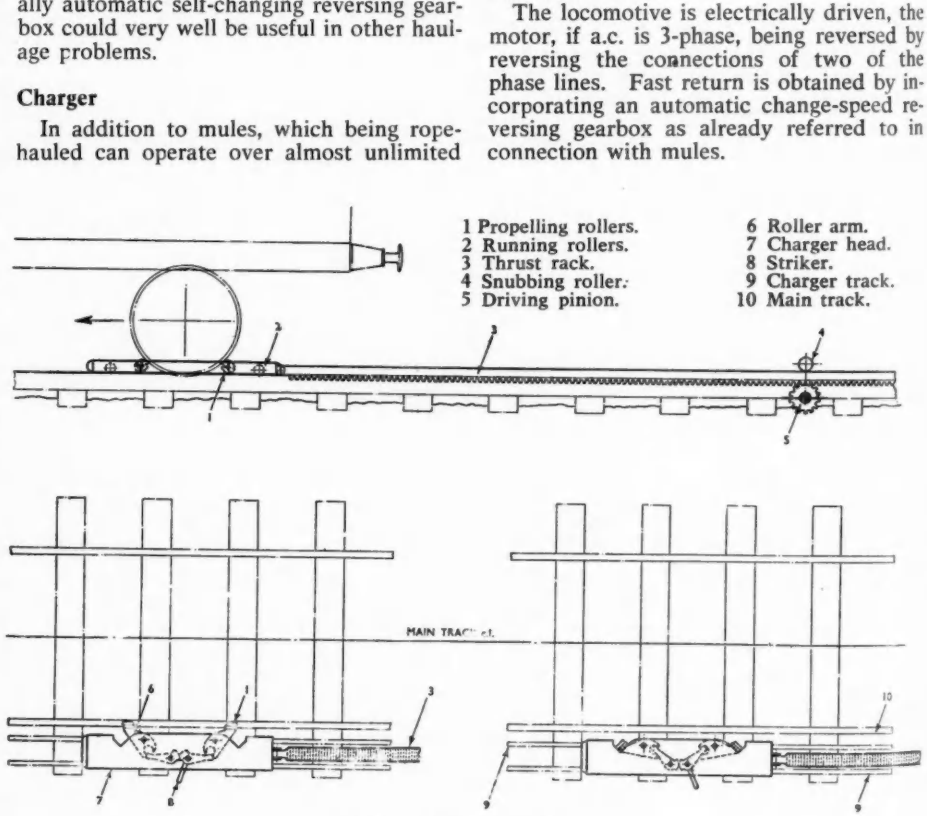
Charger

In addition to mules, which being rope-hauled can operate over almost unlimited distances, a need arose, especially in connection with the serving of wagons one at a time to tipplers and weighbridges, for a short-stroke mule. This has been developed in the form of a carriage running on independent rails alongside the main rails and carrying a pair of retractable rollers which protrude to engage both sides of one of the wheels of a wagon, Fig. 3. This device, which may be called a charger or placer, will detach wagons one at a time from the head of a rake, take them forward and spot them on the tippler. The rake needs continually to be moved forward, by other devices described, to keep the charger supplied. Interlocks between tippler and charger prevent the movements fouling each other. The charger movements would normally be controlled by the tippler operator, or be automatic.

Remotely Controlled Locomotive

For a train which is too long or heavy to be handled by any of the devices already described, the remotely controlled locomotive has been devised. This runs on the same rails as the wagons, and except when at work is parked on a short layby so as to clear through traffic. This locomotive is a simple, heavy, four-wheeled, single-purpose machine, and is free from all the drawbacks (for this duty) of a normal shunting locomotive, as it needs no driver, is very low-geared and therefore cannot produce objectionable jerky surges, and the operator is in the best place, that is, at the head of the train.

The locomotive is electrically driven, the motor, if a.c. is 3-phase, being reversed by reversing the connections of two of the phase lines. Fast return is obtained by incorporating an automatic change-speed reversing gearbox as already referred to in connection with mules.



1 Propelling rollers.
2 Running rollers.
3 Thrust rack.
4 Snubbing roller.
5 Driving pinion.
6 Roller arm.
7 Charger head.
8 Striker.
9 Charger track.
10 Main track.

Fig. 3. Wheel tread charger.

Mechanical Marshalling of Railway Wagons *continued*

Buffer Pusher

The reassembly, into continuous trains, of wagons which have been separated for service requirements has in the past been achieved, generally inadequately, by gradients. Sometimes gradients cannot be accommodated, but even where they can be, horizontal working is more satisfactory, as slow-speed power propulsion can then be adopted, resulting in elimination of impacts, completely full departure sidings, and no man-power.

Each wagon, after it has been ejected from the service station, which may be a loading, tippling, or weighing point, is allowed to run or is charged forward a short distance, about its own length. It is then slowly propelled farther forward by an amount somewhat greater than the length of one wagon, thus making room for the next free wagon, the propelling appliance being an axle mule, wheel mule, or, for heavy duty, a buffer pusher. The buffer pusher is sometimes a fixture serving only one track, or is provided with a traversing motion enabling it to serve several tracks, or is combined with a wagon traverser (described later). In any of these cases the pusher can be made to exert a very considerable pressure on the buffers, say, up to 20 tons, and is thus capable of filling the longest sidings with full wagons, all buffer-to-buffer ready for coupling up, and without impact causing breakage or (as in the case of coal) spillage, as the forward speed need generally be no more than 50-ft./min., that is, about ½ mile/h. (see Fig. 4).

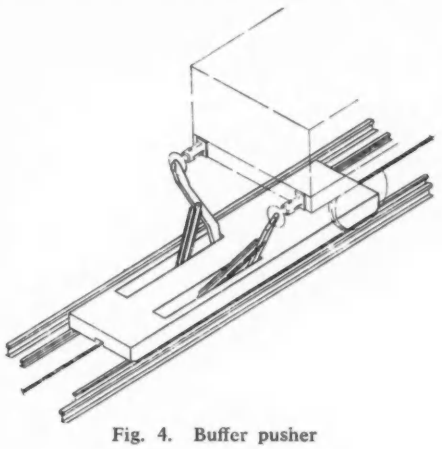


Fig. 4. Buffer pusher

PERMISSIVE CONTROL: TRACK BRAKES, WAITING STOPS, AND ARRESTERS

The devices described up to now have been of the positive propulsion type, suitable for moving wagons on the level, up an adverse gradient, or down a slightly favourable gradient.

Gravitational force may also be regarded as available for positive propulsion of wagons provided the gradient is sufficiently steep to produce a component, parallel to the track, of sufficient amount to overcome their rolling resistance and so result in motion, but a gradient steep enough to ensure that all, or nearly all, wagons will run down it, will result in most wagons accelerating rapidly. If a wagon will, on restraint being removed, start to run from rest, it will continue down the gradient with increasing acceleration Constant free running speed on an uncontrolled gradient is not realisable

For practical operational purposes, the behaviour of a wagon on an incline is completely unpredictable. Its coefficient of rolling resistance varies between the approximate figures 0.004 to 0.02, corresponding to gradients 1 in 250 to 1 in 50. This is not surprising when the independent variables are taken into account, as follows:

(1) Type of axle journal, for example, oil or grease lubricated, or roller.
(2) State of rail surface, smooth, uneven, or dirty.
(3) Summer and winter temperatures.
(4) Journals warm with running, or cold with standing.
(5) Head wind, tail wind, or beam wind.
(6) Canted and curved tracks.
(7) Brake shoes touching wheel treads (lever up).
(8) Brake shoes bearing on wheel treads (lever dangling).
(9) Wagons loaded, or empty.

A combination of only a few of the adverse conditions will result in a wagon refusing to run on 1 in 50. A combination of favourable conditions will result in a wagon accelerating on 1 in 250.

Also, a distinction must be made between a gradient on which a given wagon will be self-running at a constant speed, once on the move, and alternatively the steeper gradient which will be necessary if the wagon is required to restart after having once been stopped, the friction of rest being normally greater than the friction of motion.

Further, track laying is normally a fairly rough process. The gradient intended for an example to be 1 in 100 may fall to just 1-ft in 100-ft., but intermediately there will be undulations so that a wagon will restart in one spot but not in another. No track is dead true.

Finally, the problem is considerably influenced according to whether it is required to control wagons singly, or in rakes. If singly, the gradient must cater for the worst running wagon. If in rakes, an average may be assessed, which means guessed.

These conflictions and incompatiblities associated with gravitational running can, however, be overriden if a sufficiently steep gradient is adopted, and braking restraint applied to the wagon wheels either to check them or hold them stationary, or alternatively removed to let them run. This system may be termed permissive control, as distinct from the propulsive control of power-operated appliances. Both systems are basically positive.

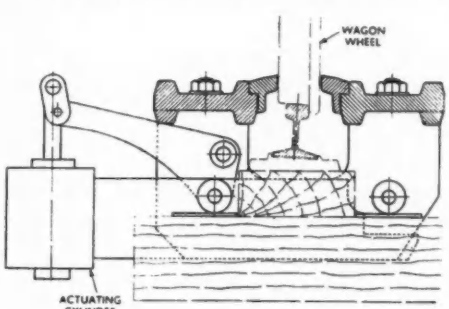


Fig. 5. Track brakes: squeezer type of wagon retarder.

Track Brakes: Squeezer Type

In one form of track brake, much used in its larger form in the railway marshalling yards, the principal is utilized of nipping or squeezing the rims of the wagon wheels between a pair of steel-faced braking beams, the braking force being applied either by compressed air with spring relief, or by spring with compressed air relief, depending upon whether the brakes are required to be normally "off" or normally "on," Fig. 5. Wagon fittings limit the height of the top of the braking beams to about 3-in, but with very strong beams and 100 lb./in.² air pressure the retarding force can be as high as 2 ton/wheel. An intermediate air pressure provides for half-strength braking, to limit severe deceleration when braking light wagons. These brakes are built in sections each 12-ft. long, which can be joined together to form continuous braking lengths, or straight or curve, to any multiple of this figure.

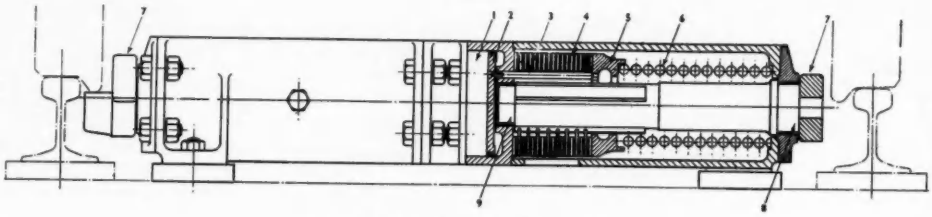
Track Brakes: Multi-unit Type

Another system of track braking makes use of the weight of the wagon to operate, by means of the wheel flanges, a series of comparatively small units each of which consists of a two-armed rocking element, the angular movements of which take place against either frictional or hydraulic braking restraint and so absorb energy from the moving wagon. A series of these units can be spaced at any desired intervals along the track as calculation or experiment may indicate. No foundations are required, the units being bolted to the sleepers or to the rail. They can be spaced well apart, at, say, 15- or 20-ft. intervals, when required for holding rakes of wagons on gentle gradients without the need to apply wagon brakes. They can be spaced at intervals to control several hundred feet of track, or they can be massed into a short length on steeper gradients for stop and start control.

The braking torque in the frictional form is applied by heavy spring pressure to a series of interleaved plates of steel and braking elements. Such brakes are normally "on," and released as required, by compressed air, which counteracts the spring pressure and leaves the rockers quite free.

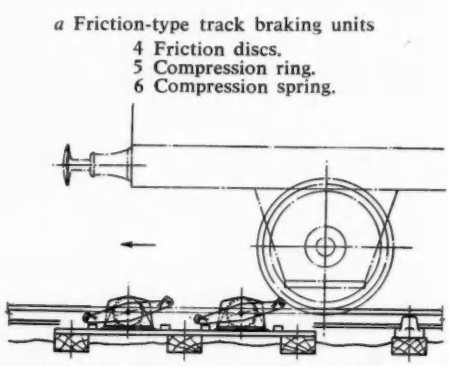
For loaded wagons, the braking force is set for the rocker to operate at a vertical load of 2 tons. The vertical movement of each pad is 4-in. The brake is usually fitted up in twin pairs for stability when bolted

Mechanical Marshalling of Railway Wagons—continued



a Friction-type track braking units

1 Air release cylinder.
2 Release piston.
3 Release push rods.
4 Friction discs.
5 Compression ring.
6 Compression spring.
7 Rocker arm.
8 End bearing cap.
9 Inner bearing.



b Gradient with remotely controlled friction units.

Fig. 6. Track brakes: multi-unit.

down to sleepers. Such a set contains 8 operative pads, which absorb, from the passage of one axle,

$$\frac{2\times4\times8}{12}=5.33\text{-ft.ton, say, 5-ft.ton}$$

For unloaded wagons, these brakes must be down-rated accordingly, so as to avoid the wheel riding on the pad instead of depressing it.

Friction-type rocker brakes can be used to provide, in any degree, permanent track braking resistance to wagons on inclines which would otherwise be too free-running, and such brakes need no relieving arrangement, being "always-on," Fig. 6a. By the used of remotely controlled air supply to the brakes they can be energized and released at will and so be used to control the progress of wagons, singly or in rakes, down a gradient, which must be self-restarting as the wagons may at times be motionless, Fig. 6b.

However, a hydraulic form of the rocker brake has been developed which possesses the useful property of automatically controlling the passage of wagons down inclines without the need for operating gear. The rocker arm oscillates a piston, forcing oil to pass through a small orifice in the piston and so flow back and forth against this constrictive resistance. The size of orifice is chosen to provide, on the heavier type, for 2 tons of vertical load on the pad. Above that loading a spring-loaded pressure relief by-pass operates, so that overloading cannot occur. The load of 2 tons is chosen to correspond to a wagon speed of about 50-ft./min. At lower speeds the resistance is less, and at zero speed the resistance is zero. From this it follows that on a self-running or self-restarting gradient these brakes, however closely spaced, will not completely halt a wagon. The intervals between brakes may be made as wide as possible short of permitting the heaviest wagon to ride down the brakes at an increasing average velocity.

In practice, gradients of 1 in 55 for empty wagons and 1 in 65 for loaded wagons have been found satisfactory. The wagons move gently and quite automatically down the gradients, at speeds which, notwithstanding their varying running characteristics, do not differ very much, and approximate to ½ mile/h., say, 50-ft./min., at close spacing, Fig. 7.

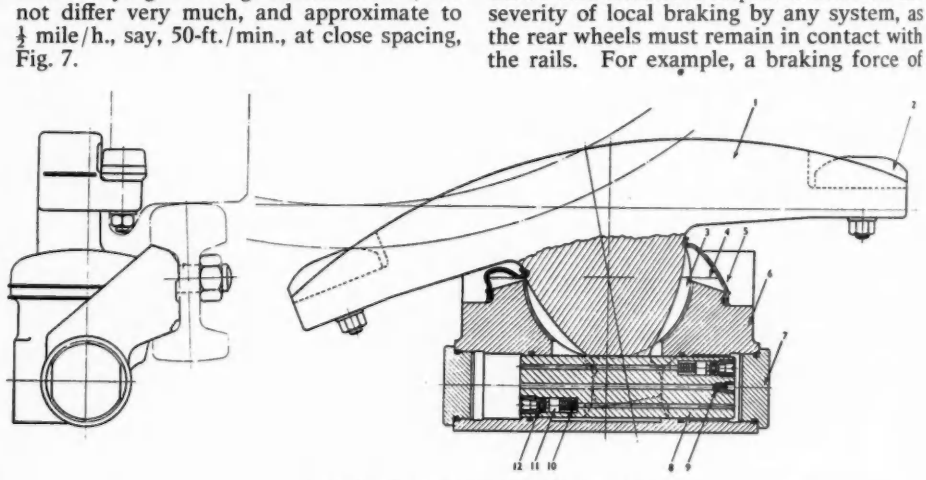
When necessary, external control of the hydraulic circuits can be applied, thus causing the brakes to halt wagons and hold them. The protection of the overriding pressure relief remains.

A feature of the multi-unit track brake, frictional or hydraulic, is the high degree of dependability, as any single unit can be removed for attention without its absence having any noticeable effect on general performance.

With both types of unitized brake, the performance is scarcely affected by weather conditions, as the braking elements, whether frictional or hydraulic, are totally enclosed.

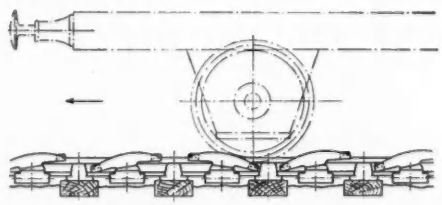
A battery of these unitized brakes cannot, however, on account of its non-continuity and dependence upon wagon weight, provide the same powerful localized braking force, where that is required, as the squeezer type which operates on the sides of the wheels. The maximum yet attained with unit types is, with the friction type 1-ft.ton/ft./axle, and with the hydraulic type 0.6-ft.ton/ft./axle. Under favourable conditions the squeezer type produces 4-ft.ton/ft./axle.

With any method of braking, however, the act of applying the brake results in a redistribution of wheel pressure on the rails, more weight being thrown on the leading wheels and less on the rear wheels. The extent of this redistribution is a function not only of deceleration and weight, but of wheel base and height of centre of gravity. These considerations impose a limit on the severity of local braking by any system, as the rear wheels must remain in contact with the rails. For example, a braking force of



a Hydraulic-type track braking unit.

1 Rocker arm.
2 Wheel pad.
3 Rocker journal.
4 Oil surfaces.
5 Flexible gaiter.
6 Body.
7 End cap.
8 Piston.
9 Bleed jet.
10 Pressure relief spring.
11 Pressure relief needle.
12 Pressure relief seat.



b Hydraulic units on gradient providing automatic speed control.

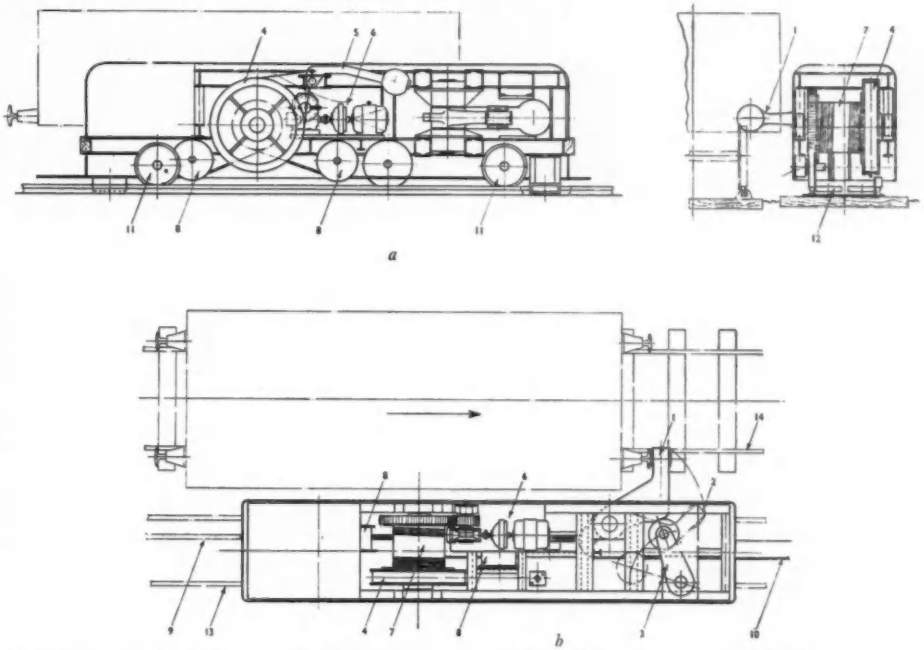
Fig. 7. Track brakes: hydraulic type

Mechanical Marshalling of Railway Wagons—*continued*

2-ft.ton/ft. aplied to an empty wagon of 6 tons weight would result in the rear wheels lifting off the rails. From such considerations it follows that unitized track brakes of fixed braking power must be rated to suit the lightest wagons and spaced to suit the heaviest. Therefore the greatest economy of installation is realized when the axle weights are fairly constant.

Waiting Stops

When it is desired to hold a wagon or a rake on an incline, this can be done by the use of retractable stops put in the path of the wagon wheels, and these stops, which may be termed waiting stops, need not be designed to yield, provided the wagon is brought slowly into contact with them, and this slow approach is automatically ensured by the hydraulic track brake. Fig. 8 shows the form the design takes when used in conjunction with wagon traversers described later. The face of the stop is given a curvature of radius a little greater than the wagon wheels, thus avoiding sharp impact and substituting a slight wheel rise. The stop is lowered by external force applied to the supporting roller, and rest by the action of a powerful spring. When used in conjunction with other units for sequence operation, electrical interlocks ensure that the stop cannot be lowered until the next unit in sequence is ready. The wheel, and its axle, would appear to provide the only two places at which separating or holding forces within the overall width of the wagon can be applied when wagons are in buffer contact. Wheel waiting stops are useful in that they ensure a constant wheel-waiting position for a further forwarding appliance of the type which embraces axles or wheels. Buffer stops do not provide constant wheel positioning.



1 Buffer arm extended.
2 Buffer arm retracted.
3 Locking arm.
4 Brake drum.
5 Brake arm.
6 Drive unit.
7 Rope barrel.
8 Rope deflectors.
9 Main ropes.
10 Tail rope.
11 Wheels.
12 Side-thrust rollers.
13 Side track.
14 Main track.

Fig. 9. Arrester charger.

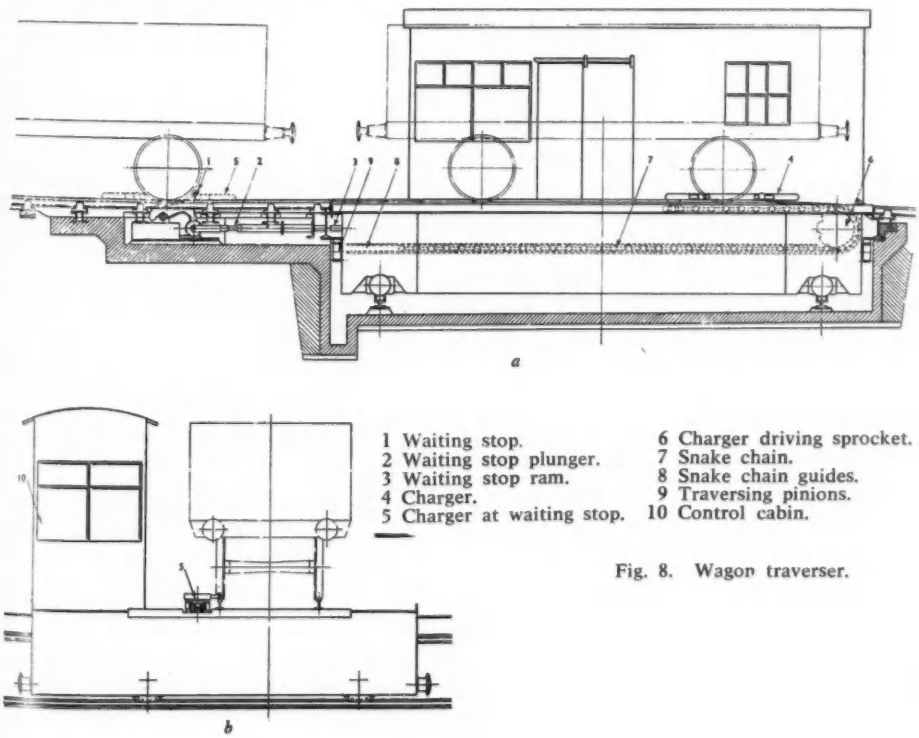
Arresters

Although braking control of wagons on gradients, automatically or otherwise, is now possible, there are cases where the installation of the brakes is not practicable due to economic or local site reasons. Frequently wagon tipplers have been installed with free-running downgrade approach tracks to facilitate wagon movements to the tippler, but often this has resulted in serious collision between run-away wagons and a partially rotated tippler, causing much damage and delay.

The answer to this problem has been elusive, but a device which combines the twin purposes of safeguarding the tippler and serving it with wagons has now been developed. It takes the form of a heavily weighted carriage running on rails laid to one side of the main rails and having a pivoted retractable buffer arm. The carriage can be motored in both directions, but when the protruding arm is hit by the leading buffer of a run-away rake the whole car is carried along against a heavy braking resistance for any chosen distance, say, about 40-ft. In this manner an amount of kinetic energy amounting to several hundred ft.tons can be absorbed.

When performing charging duties, the brake is released only when the travelling circuit is energized, and heavy buffer pressure also cuts the circuit through a non-resetting limit switch.

This car, or arrester, works in conjunction with the wheel-type waiting stop. The arrester, by first lowering the rake of uncoupled wagons down the gradient to the waiting stop which is brought into operation against the second wagon of the rake, then continuing its forward motion followed by the leading wagon, can act as a charger for a tippler, thus combining two functions.



1 Waiting stop.
2 Waiting stop plunger.
3 Waiting stop ram.
4 Charger.
5 Charger at waiting stop.
6 Charger driving sprocket.
7 Snake chain.
8 Snake chain guides.
9 Traversing pinions.
10 Control cabin.

Fig. 8. Wagon traverser.

Mechanical Marshalling of Railway Wagons—*continued*

TRANSVERSE MOVEMENTS: TRAVERSERS AND ASSOCIATED EQUIPMENT

Traverser

It is frequently very convenient and economic in money and space to incorporate in wagon-marshalling layouts the well-known principle of the wagon-traverser. But, although the basic principle is not new, the form it now takes embodies features not previously developed, and this is mainly due to the ease with which the basic idea of the traverser lends itself to mechanisation in conjunction with the developments described in the previous section.

The traverser is now built suitably for handling wagons on continuous duty cycles at the rate of up to 1/min., taking wagons one at a time from any one of the series of parallel tracks and transferring them to any one of another series of parallel tracks. Thus, a high throughput for cycle working is made possible by providing the traverser withs own built-in mule for reaching out and bringing the waiting wagon on to the traverser table, holding it there during the traversing movement, and ejecting it either on the same side or the opposite side on reaching the selected despatch track.

The traverser may be of the straight-through or back-shunt type. In the straight-through type, rail matching must be to close tolerance at both ends of the traverser.

The fewer times wagons need to be stopped and started, the greater the efficiency of any wagon-marshalling installation, and this principal has been incorporated in the traverser by equipping it, when required, with a weighbridge.

A traverser cannot operate at its full potential capacity unless wagons are made immediately available to it at each station. This is done by providing a series of wagon waiting stops on the approach tracks which serve it. These need to be designed as mechanisms integrally associated with the traverser, as interlocks between the traverser and the waiting stops are essential elements of safe and fast working.

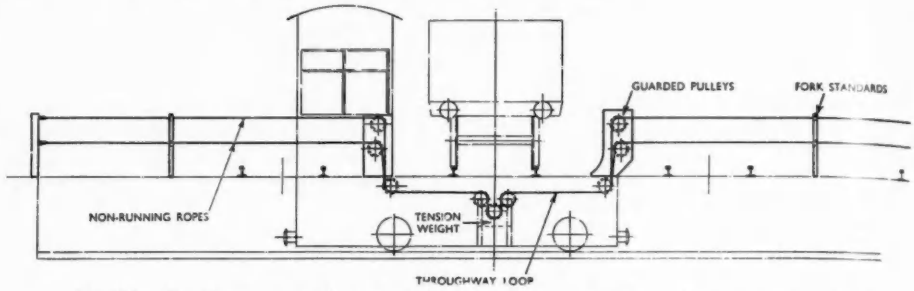


Fig. 10. Showing a method of providing hand rope protection of traverser trenches.

By one arrangement, the waiting stops can only be lowered by means of a mechanical thrust from a horizontal ram carried on the traverser, under the control of the traverser driver, and which cannot be operated until locating bolts on the traverser have entered register holes in the side of the traverser pit, which they can do only when the traverser rails are in correct matched alignment with the ground rails. The stops can be operated from no other place than the traverser control cabin, which makes for complete safety.

Buffer Pusher

A traverser can be equipped with a wagon pusher for use in the departure sidings, and this is now being done. For this heavy duty it is necessary to push on the buffers, and in one design the pusher takes the form of a buffer mule provided with pusher arms which are raised into position as the mule is rope-hauled forward, the wagon being pushed clear by the mule which then returns. In another design the pusher is mounted on the traverser but offset to one side, so that after ejecting the wagon the traverser has to take up a new position in order to bring the pusher opposite the ejected wagon. For high-speed working, say, 60 wagons/h., these methods take too much time out of the cycle, and independent pushing must be employed, the traverser then having only to eject the wagon.

Rope Handrails

The objection that men may accidentally fall into the unguarded open traverser pit has been overcome by the invention of the running loops. Single-rope or double-rope lines are fixed along the edge of the traverser pit and are supported at intervals by fork standards. The traverser carries several guarded pulleys, around which these ropes are led, to provide clear wagon passage only at the position occupied by the traverser, the pit being guarded at all other places. The ropes are stationary at all points where they can be touched by men; only the loops move, and they are invisible.

It would appear that this protective device could, if though worth while, be applied to large railway turn-tables.

Containers and the Shipping Industry

Research in the United States

A report on research organised to determine the optimum sizes and the economic feasibility of shipping containers has been published by the Department of Engineering, University of California, Los Angeles. As the author, Joseph D. Carrabino, states, the carriage of containers represents one of the most promising innovations in the world-wide shipping industry, for "the high costs of loading and unloading ships have focussed attention on the critical need for developing more effective handling methods."

The report, which runs into nearly two hundred pages, includes many illustrations, tables and calculations. The general reader will, however, be mainly interested in the "summary and conclusions," an abstract of which is printed below.

In January, 1955, a direct mail survey comprising one hundred and six letters was initiated regarding the use of shipping containers in water, land, and air transportation networks. Seventy responses from shipping companies, educators, military installations, and manufacturers throughout the United States and several foreign countries provided a wealth of information which, supplemented by a library search and numerous visits to shipping companies in the Los Angeles and San Francisco areas, gave a comprehensive picture of the "state of the art" of containerisation. These preliminary efforts led to the following consensus:

1. The problem of the determination of the optimum size or sizes of shipping containers appeared to be a crucial one. There seemed to be no agreement whatsoever on this problem.
2. Likewise, there appeared to be a lack of feasibility of containerisation over conventional methods of handling, such as palletisation.
3. The chief advantages claimed for containers were:
   (a) Speed up the loading and unloading of all types of transport—rail, ship, air, road—thereby reducing turn-around time.
   (b) Protect against pilferage and damage of commodities.
4. The chief disadvantages claimed for containers were:
   (a) Loss of cubage in the container because of the impossibility of achieving perfect stowage of different size packages in a given size container.
   (b) Loss of cubage in ships due to the wall thicknesses of containers and the broken stowage occasioned by the difficulty in stowing containers perfectly in different stowage compartments.
   (c) Cost of returning empties when no retrograde cargo is available.

After considering the many problems posed by containerisation which might yield to engineering modes of analysis, the decision was made to place the main focus of the research effort on the crucial need for the development of methods for:

1. Determining the optimum sizes of shipping containers.
2. Determining the economic feasibility of containerisation.

Containers and the Shipping Industry—continued

An empirical approach using operations analysis techniques was employed. Arrangements were made with the American President Lines in San Francisco to use actual performance data for all commodities which were shipped over a typical trade route by two sister ships on eight consecutive voyages.

The dominant factors affecting the sizes of containers which were investigated in this study are:

1. The weight ton and measurement ton distributions of all physically containerisable commodities for different density and stowage factor intervals.
2. The fit of different size packages into different size containers.
3. The fit of different size containers into all the storage compartments of the two ships.
4. The influence of truck, railroad car, and aircraft sizes.

The separate effect of each of these factors was first determined. Then the interrelationship between them was considered for three different circumstances in which shipping containers might be used. The circumstance which represents the desirable long-run situation which will maximise the benefits of containerisation to shipping companies, labour and shippers, is the one in which containers are used interchangeably from trucks, railroad cars, and occasionally aircraft to ships, and large numbers are loaded on a ship at any one time. In this situation the influence of truck and railroad car sizes would serve to fix either the optimum depth or width dimension. The optimum height dimension would be determined by ship fit considerations. The desirable volume range of the container would be established from an analysis of the density and stowage factor distributions of the physically containerisable commodities. The optimum selection of the remaining dimension within the desirable volume range would be established using SWAC Matrix relationships in order to minimise internal cubic losses.

Operational Advantages and Disadvantages

The economic advantage or disadvantage of containerisation over palletisation varies from commodity to commodity. For 33 different commodities the dollar savings or losses per measurement ton were determined for the case where each of these commodities is containerised instead of palletised. These savings and losses indices were determined for three different size containers. For each size container a determination was made for the situation where the maximum permissible weight limit on the ship's boom was 6,000 lb, and another determination for the case where the limit was assumed to be 12,000 lb. The intent here was to demonstrate the desirability of "beefing up" the booms to carry heavier lifts per load and thereby increase the productivity.

The savings and losses indices suggest the concept of a containerisation priority index by commodity. If an operating man knew these indices for all containerisable commodities he would be able rationally to decide the order in which commodities should be assigned to containers. The estimated annual savings of containerisation over palletisation and the per cent. return on investment in containers were determined for different levels of containerisation.

The economic analyses demonstrate that the potential dollar savings of containerisation are staggering. This evidence strongly supports the statement made earlier that people in the shipping industry believe that containerisation of general cargo represents the most promising innovation in the world-wide shipping industry. The author predicts that the attractive investment opportunities offered by containers will result in the formation of companies that will engage in the rental business.

To exploit fully the benefits of containerisation in the short run there should be standardisation of container sizes within the shipping industry. Then, national container systems should evolve with size standardisation agreed upon by all types of carriers. Ultimately, international container systems will probably evolve. Such systems would probably serve as an impetus towards the much-needed standardisation of packaged sizes.

Increased levels of containerisation should simplify the setting of productivity standards and thereby make the cargo handling system more amenable to the application of wage incentive plans. Such plans should receive serious consideration in an industry which appears to rely heavily on the "art" and lightly on the "science" of management. The author would like to warn the industry that incentive plans could be sources of much grief. The engineering of simple and effective plans should not be entrusted to simple people. The field of industrial engineering has for years been infested with charlatans. The newest star in the efficiency universe called "operations research" shows an even higher degree of infestation. Management is cautioned to scrutinise carefully the qualifications of individuals and organisations before engaging their services. The author has felt for a long time that incentive plans would provide a much-needed stimulus to the industry. He would not like to see an ill-conceived attempt destroy the receptive atmosphere which appears to exist to-day.

The author would like to highlight the tremendous costs of time, effort, money, patience, and ingenuity involved in procuring, reducing and analysing data for this type of study. It is his opinion that these large costs are neither sufficiently nor generally appreciated by theoreticians in the expanding group working in the operations analysis or operations research field. These costs are particularly high in the shipping industry where paucity of operating data appears to be a common characteristic.

It is the author's opinion that management and labour groups in the shipping industry are in dire need of the kind of "mental revolution" which has taken place in manufacturing industries under the impact of scientific management philosophies and techniques and under the absence of government largesse.

The author hopes that if this research effort does nothing more than demonstrate the efficacy of analytical techniques in solving operational problems it has high-lighted a critical need. "Rule of thumb" methods must yield to scientific methods if increasing complexities are to be successfully coped with. Operating people, even if analytically equipped, do not have time for analysis and reflection because of the pressures of day to day problems. There is no substitute for managerial and technical know-how, not even the palliative of human relations which some people are currently dispensing with fantastic and operationally untestable claims about its tranquillising effect on industrial discord. Underlying the philosophy of managerial control is the need for predetermined standards of performance, a measure of actual performance, and a periodic comparison of these two factors in order to provide a basis for corrective action. The implementation of such a programme of control requires measurements and analyses. The author would like to recommend strongly to line officers in the industry that they supplement their knowledge and efforts with properly trained industrial engineering or operations research staffs.

Suggested Recommendations

The author would like to close this "story about a box" with several recommendations regarding the implementation of a containerisation programme in a shipping company. Such a programme will undoubtedly have an impact on every phase of the company's activities. Reverberations resulting from this innovation will be felt not only within the company but also by all external groups with whom it conducts business. New concepts of packaging, selling, warehousing, ship design and materials handling, not to mention manufacturing, can be expected to develop. In the opinion of the author no one individual in a company has the span of knowledge and experience to qualify him to "call all the shots" in a containerisation programme. Modesty in this instance is not only a virtue but an economic necessity. Passions for anonymity and teamplay are also desirable concomitants.

Initially it would probably be desirable to appoint a policy committee comprising representatives from the top echelons of each of the major departments in the company. This committee should report to the top administrative officer of the company. Without strong support and direction from top management it is likely that the programme will flounder. Committees are notably inefficient mechanisms when it comes to performing fact-finding functions and executing policies. Therefore, a staff should

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Repairs to Floating Caisson

Royal Edward Dry Dock, Avonmouth Docks

The floating caisson which closes the entrance to the 875-ft. long Royal Edward Dry Dock at Avonmouth is a wrought iron skin plated and steel framed box-type floating caisson, 100-ft. long, 20-ft. wide and has a draft of 28-ft. The caisson with its cast iron ballast weighs 1,389 tons and was constructed in 1908.

Since this date the original greenheart horizontal and vertical clapping timbers, provided on both faces of the caisson, have been in constant use and by 1958 their condition was such that leakage, particularly at the bottom corners, was excessive. The iron and steelwork of the structure was not heavily corroded, but the renewal of the greenheart timbers was urgent. The use to which the Dry Dock was put during the war years precluded the possibility of carrying out any maintenance repairs and after 1945 the Port Authority was faced with the problem of finding ways and means of dry docking and overhauling this caisson.

Underwater replacement of the greenheart clapping timbers was out of the question as constructional details involving the fastening of the timbers to the caisson would have made it extremely difficult for a diver working in a restricted space beneath the caisson.

There remained two alternatives, either the construction of a cofferdam across the existing dry dock entrance and dry docking the caisson in its own dock, or towing the caisson to another dry dock. The former proposal would be costly and put the dry dock out of service for too long a period.

Of the many dry docks available within the Bristol Channel, few were capable of accepting such a deep draughted vessel as the caisson and then only under certain conditions involving the reduction of the draft of the caisson by removing the ballast. When an attempt was made to remove the ballast, it was discovered that the cast iron blocks were firmly set in a hard mortar of cement and iron filings and other remaining spaces filled with a concrete made with old steel and iron punchings as a coarse aggregate. To have removed the ballast would have been very costly and time wasting.

Fig. 1.

In June, 1958, Mountstuart Dry Docks Ltd. submitted a proposal to reduce the draft of the caisson, by the use of two salvage camels, to an amount sufficient to allow dry docking at their Eastern Dry Dock, Newport. Ultimately a contract was awarded to this company for the dry docking, overhaul and repair of the caisson. The camels used were hired from the Admiralty and were 33-ft. long x 13-ft. dia. each with a lifting capacity of 80 tons. After removing a proportion of the ballast and with the camels in position, the draft was reduced to 24-ft. The camels were fastened, one each side of the caisson, with chains and shackles to large lugs provided with eyes welded to the side of the caisson. Fig. 1 illustrates the caisson with the camels about to be submerged and Fig. 2 shows the submerged position ready for towing across the Bristol Channel.

On inspection of the caisson in the dry, it was discovered that the wrought iron retaining angles for the greenheart timbers on one of the faces, which had been in almost constant use against the granite cills of the Dry Dock, required to be renewed. These were renewed in rolled steel using mild steel rivets. The wrought iron plated skin of the caisson was found, after cleaning down, to be in a remarkably good condition after 50 years' constant service. Some local pitting was discovered which was made good with iron filings and gold size. Otherwise the plating had wasted on an average of about 8 per cent. Certain plating repairs were necessary to the exposed external end frames of the caisson which had suffered abrasion with the masonry of the sides of the recess rather than by corrosion. All the greenheart and vertical clapping cills on both faces were renewed using galvanised steel bolts. The bottom corners, on each face of the caisson, where the vertical and horizontal timbers were set and where wear is greatest, were renewed using short lengths of timber, butt jointed to the main lengths of timbers and fastened with phosphor bronze bolts to facilitate subsequent removal and replacement.

Internal and external faces of the structural steelwork and wrought ironwork plating after minor repairs by way of riveting, etc., were scaled and cleaned and coated with two coats of "Epilux 5" an Epoxy Resin/Coaltar mixture manufactured by British Paints Ltd. The repairs to the caisson took 42 days to complete.

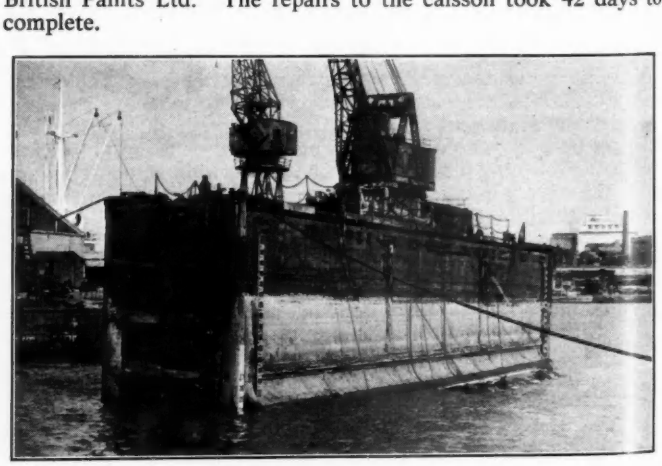


Fig. 2.

Containers and the Shipping Industry

(Concluded from previous page)

be provided to assemble facts, analyse them, and prepare recommendations on which the pooled judgment of the Committee members can be brought to bear thereby achieving a "systems" point of view. The participation of each of the major departments in the company will not only be salutary from the standpoint of engendering support and co-operation but there is an educational aspect which is often overlooked or little appreciated. The departmentation of company activities results in a situation where people begin to feel "their department" is the hub of the company wheel and the others are mere spokes or foreign appendages generating a disproportionate amount of overhead expense.

A mechanism should be devised to follow through on the policies agreed on by the committee. This may be an individual called the Co-ordinator or Director of the Containerisation Programme or it may be the Executive Vice President or it may be the President. Whatever the title, this man should be at the general management level with authority cutting across traditional departmental lines. As with all management systems the personalities of the personnel constitute major parameters. It is difficult to generalise. However, the author feels that entrusting the programme to any one of the functional departments would lower considerably the odds of achieving success.

The author would like to caution on the importance of the timing element when introducing a new system. A sufficient period of gestation and assimilation has to be allowed for at each phase of the programme. Resistance to change is a characteristic of human behaviour which we consider a malaise in others but which we seldom recognise in ourselves. This factor could very well be a controlling one.

The Refrigerated Cargo Liner

Conveying and Handling Specialised Cargo

The Institute of Transport's Annual Shipping Lecture was given last month by Mr. F. E. Harmer, C.M.G., chairman and managing director of the New Zealand Shipping Co. Ltd., and was entitled "The Refrigerated Cargo Liner." Abstracts of the address are given below.

Mr. Harmer began by saying that he proposed to deal mainly with the refrigerated cargo ship in its relation to the countries of Australia and New Zealand, in the growth and development of which it has played so essential a part.

The first successful shipment of meat under mechanical refrigeration was in 1877, when a shipment was carried from Buenos Aires to Le Havre in the small steamer "Paraguay." For this an ammonia compression machine was used which carried the cargo at −17°F. Two years later meat was shipped from Australia to the United Kingdom in a chartered ship, the "Strathleven." In this case it was chilled rather than frozen and carried by means of a machine which circulated dry air at 30°F.

In 1881 P. Henderson & Co. of Glasgow fitted out their sailing ship "Dunedin" of 1,320 tons with a similar machine to "Strathleven's," and, in spite of difficulties, including the breakdown of the refrigerating machinery, the vessel made a 98 day voyage, not without incident but without serious disaster. The cargo was almost entirely carcases of mutton but there were small trial shipments of butter and eggs as well. This voyage definitely established, as far as New Zealand was concerned, the practicability of transporting refrigerated produce.

The earliest shipments were a matter only of a few hundred tons of cargo in chambers totalling some 15,000 cu. ft. or thereabouts. Within a very short space of time the number of ships, and of shipowners, engaged in the trade had multiplied and ships with refrigerated capacities of 100,000 cu. ft. were the order of the day only two years after the "Dunedin" successfully discharged her cargo. Sixteen years later the normal refrigerated capacity of the vessels in the New Zealand trade had increased to 250,000 cu. ft. Now it has reached something like double that figure. Taking New Zealand again as an example, in 1882 750 tons of meat were shipped, while ten years later the total had increased to some 40,000 tons. To-day New Zealand and Australia export well over half a million tons to the rest of the world, together with substantial quantities of dairy produce, i.e. butter and cheese. A similar growth pattern will be found for South America.

The Refrigerated Ship

In describing the kind of ship required nowadays for the trade, Mr. Harmer stated that in the case of refrigerated cargoes, the limits of size are more quickly reached than in the evolution of tankers, and this is due, on the one hand, to the nature of the cargo and, on the other, to the nature of the ports which have to be served. With perishable produce, the ship is only one link in a long chain that begins on the sheep or cattle station and ends in the butcher's shop. At each stage of this chain the produce requires complicated and possibly costly handling, and each stage requires expensive installations; of meatworks, of cold stores on shore at each end of the chain, and of insulated or refrigerated transport, road or rail, for assembling in the first instance and distributing at the latter end. The ship therefore must not require, in order to fill, a larger quantity than the storage facilities in the country of loading can conveniently assemble and deliver to it expeditiously, or than the labour force and port facilities of the country can reasonably handle. Similarly at the discharging end.

The typical large ship of present day practice is in fact a vessel of some 530-ft. in the waterline, some 11,000 gross tons and possibly up to 12—14,000 tons total deadweight. She will generally but not invariably be propelled by diesel engines rather than by steam and she will have a service speed of 16—17 knots. Her refrigerated cargo capacity will be around 500,000 cu. ft. and, in addition, she will have somewhere about half that capacity of general cargo space.

The refrigerating machinery, which is housed in a separate engine room in a tween deck midships, will consist of electrically driven piston compressors operating on a carbon dioxide cycle, although modern practice is now tending towards the newer refrigerant fluids such as Freon and Arcton. The importance of using air cooling is that temperatures can be regulated far more exactly and all spaces can be maintained at a much more even temperature than under the old practice of using brine.

The ship in question will have something like two dozen different spaces separately insulated and capable of carrying cargoes at different temperatures. The temperatures demanded for perishable cargoes have a very wide range. At one extreme there is the quite recent development of deep frozen produce which does not yet move in very large quantities but is nonetheless an important and, possibly, a growing element in world trade. For this a temperature around zero F. or even below is desirable. Next come the so-called hard frozen items namely butter and meat. These are carried around 12—14°F. Next comes chilled meat around 29°F., fruit at various temperatures between 31 and 38° and, finally, cheese which may be carried at as high a temperature as 47°. Thus what starts by sounding quite a simple proposition of distributing cold air throughout the ship becomes in practice highly complicated because of the necessity of maintaining all these different temperatures, in some cases extremely accurately. Chilled meat, for example, will not tolerate a range of temperature of more than half a degree either side of the prescribed carriage temperature.

The fact of insulation itself contributes something to the complexity of the ship as a structure. All projections such as flanges of beams, frames, etc., must be kept as small as possible so as to allow a sufficient depth of insulation over these metal projections, and the normal depth of insulation is no more than about 10-in. Moreover, the insulation must be secured to the ship's side and deckheads and bulkheads by means of fastenings which inevitably involve the use of metal and may therefore be good conductors of heat. There is considerable ingenuity required in designing these fastenings so as to minimise the loss of heat thereby.

Cargo Handling

Finally Mr. Harmer turned to cargo handling. Nowadays by far the greater part of world trade in terms of tonnage can be pumped in and out of ships, or poured in and sucked out or handled by other mechanical means which do not involve any manhandling whatsoever. With refrigerated cargoes, however, the advances in this particular field are regrettably limited. The nature of the cargoes does not lend itself readily to bulk handling, and moreover they are usually seasonal in their movement. To get the best economy out of bulk handling methods requires the best possible load factor and that is not achieved when dealing with commodities which only move during part of the year.

Even so, some attempts are being made to progress along this road. Goods that can readily be cased are suitable to handling by means of pallets and fork-lift trucks and this type of handling is beginning to appear in some ports. But where one is dealing with, for example, carcase meat, palletisation is not easily achieved and the most hopeful line of development so far seems to be some type of conveyor belt which will feed carcases into the ships' compartments. Such installations are being developed and one may hope that they will develop further. But they are cumbersome and in view of the seasonal nature of the cargoes it is difficult to get sufficient utilisation of the heavy capital expenditure involved to justify it.

It may perhaps be suggested at this point that conveyor belt handling could be greatly simplified by the use of side-ports in the ships themselves. This has been tried and in some cases—though more in other trades in other parts of the world—has made headway. But side-ports have great disadvantages from the structural point of view. They are very susceptible to contact damage, which destroys the water-tightness, disturbs the insulation behind them and thereby makes the spaces into which they open troublesome for the carriage of refrigerated cargo. Moreover ships have lower holds which cannot be reached by means of side-ports, so there is still the need to drop the cargo down below inside the ship and there is not much simplification in feeding it to a lower hold through a tween deck rather than

The Refrigerated Cargo Liner—continued

through a hatch on the weather deck. Admittedly it may be possible to achieve all-weather working by using conveyor belts into the ship's side and this can be a substantial advantage; but it may possibly be achieved also with working into ship's hatches and it is doubtful whether the use of side-ports is likely to contribute very much to the future economy of handling these cargoes. However, since handling costs are a very large part of the total costs of carriage and since freight is quite a substantial element in the landed value of the commodities concerned, all advances in this field do require to be most carefully studied and encouraged if they show any promise of success.

In conclusion Mr. Harmer said he had referred chiefly to the larger units at present in service and they are by no means the only ones. "The economies of size can be best realised in a trade moving in a substantial volume and regularly between a small number of ports. Where however small quantities have to move to a variety of ports a smaller vessel may prove to be handier and more economical and you will in fact find therefore that the trade is served by ships of a certain range of size, down to perhaps two-thirds of the capacity figures I have mentioned. None of them, however, is very small, by which I mean comparable in size with the small fast highly-insulated fruit carriers which are usually employed for carrying bananas or citrus fruit. These I must leave out of consideration and I must also leave out of consideration the ships which serve the River Plate trade. These are large, like those of the Southern Dominions, but their specialisation has taken different forms arising out of the different character of their trade."

New Liverpool — Belfast Ferry Service

The first regular road vehicle and container service to be operated from Liverpool was inaugurated in January by a new company, the Link Line, Ltd. (a member of the Coast Lines Group of companies). With headquarters in Belfast, this company has been formed to operate a nightly service in each direction between Liverpool and Belfast with two motorships of about 1,200 gross tons, the "Pointer" and "Spaniel."

At each terminal, facilities have been provided for parking road vehicles arriving at the quay and a 15-ton Butters crane has been installed at both quays for handling the vehicles and containers. The vessels can carry between 32 and 36 trailers and containers each trip, the trailers being stowed below deck in the 130-ft. long hold. There is room on the flush deck for about 12 containers, three abreast.

The Company is providing a regular service for unit loads of all types, vehicles, trailers, large containers, Lancashire flats, bulk liquid tanks and other similar units. It also has a range of light alloy containers of 12 tons capacity each for customers' use.

These have underframe and flooring of either tongued and grooved timber or light alloy planking. The sides, side framing and roofing are formed from one-piece extruded panels bent to U-shape. A projecting external flange retains a weatherproof seal. The shell interior is thus smooth and frameless. Special door framing sections obviate the need for rubber sealing—an important feature when sea transit is intended. The container shell is an assembly of interchangeable components, all of which are available for self repair. Rubbing strakes are fitted diagonally to obviate damage while in the hold, and the lifting eyes each have a three-point mooring on the base of the container. When thermal insulation is required, insulating boards are attached to sides, front and rear of the container shell interior; the insulating medium provides a ¼-in. air space between the inner and outer skin. The final interior and floor are lined with alloy sheet.

As there are no tidal restrictions at Belfast, and the Waterloo Dock at Liverpool allows berthing at any state of the tide, the ships will be able to make an overnight passage, departing about 6.30 p.m., to begin discharge at both ports at 8 a.m. These regular sailing times will fit in well with road transport schedules, and the Liverpool Cartage Company Ltd. (another member of the Coast Lines Group) will supply haulage requirements in Liverpool and also carry out some of the quayside shunting movements.

Method of stowing trailer. Scammell unit will unlink to leave the trailer only in the hold. Note the trestle placed under the trailer to take the place of the bogey wheels and provide support.

To ensure a comprehensive service, arrangements have been made for the Company to work in co-operation with the Belfast Steamship Co. and the Belfast, Mersey and Manchester Steamship Co. who, between them, provide two general cargo sailings a day between Liverpool and Belfast and have special facilities for the smaller type of containers of up to 4 tons capacity. Through these organisations the new company hope to meet the needs of shippers who offer traffic which is not suitable for unit loading.

General view of hold, looking forward.

A possible development arising out of the new service is the transhipment of container cargoes from deep-sea vessels. More deep-sea ships are now carrying a proportion of their cargo in containers; there is also a growing traffic in the movement of unit loads between the Continent and Northern Ireland making use of similar services operating on the sea routes between near Continental ports and Tilbury, Dover, Felixstowe and East Coast ports. Handling methods used at Liverpool and Belfast are similar to those at other container terminals.

Trailers arriving at the quayside are lifted by crane and secured at their front ends on stands in the hold. There and on the container deck are a series of steel openings of cruciform pattern, into which the locking devices, known on account of their shape as "elephants' feet" are put. Alternatively, trailers or other unit loads are pushed on to a steel loading platform by tractor and are then lowered into the hold by crane. A second tractor in the hold moves them to their final stowage position and is lifted out on completion of loading. During discharge the operation is reversed.

Containers are slung direct from the body of the road vehicle and stowed into position on deck. Bottle screws and chains attached to the elephants' feet are used for lashing down. Loading and discharging operations can be completed during the day, up to 700 tons being handled in 12 hours.

Before commencing the new service, the owners held conferences with the dockers in both terminal ports and secured an agreement for the unions to co-operate.

Container and road vehicle traffic to Northern Ireland has been one of the most important developments in the Irish shipping trades since the second World War, but although the proximity of Liverpool to the industrial centres of the U.K. makes the port an attractive one from the point of shippers, the Link Line are the first concern to start a regular service specifically for this type of traffic.

The Port of Bremen

Development of a New Dock Area

By DR.-ING. RALPH LUTZ
(Director of Port Construction)

Introduction

AN article by the present author on the docks of the Free Hanse Town of Bremen was published in "The Dock and Harbour Authority" for August 1956.

About the time when that article was written, the Klöckner Concern, Duisburg, acquired a blast-furnace plant at Bremen—known as the Norddeutsche Hütte—from the firm of Krupp. At the same time the Klöckner Concern negotiated with Bremen the purchase of a site situated downstream of, and adjacent to, the Norddeutsche Hütte with a view to erecting a steelworks and rolling mill on it. In Fig. 1 of the above-mentioned earlier article the site in question is marked "land for future extension of port."

It was realised that the existing harbour serving the Norddeutsche Hütte would not be adequate to meet the requirements of the new plant. Besides, the dimensions of the lock giving access to this harbour (and to the rest of the system constituting the Industrial and Commercial Docks) are such that vessels of fairly deep draught cannot use it. The only alternative to building a new lock would therefore be to locate the berthing and cargo handling facilities for the larger vessels **before** the lock in question.

The new dock area before the lock has now reached an advanced stage of development. The scheme has involved the demolition of the villages of Mittelsbüren and Osterort, whose names have been commemorated in those of the new harbour works. The whole dock area concerned has been named "Mittelsbüren Docks." The berths are designated as "Osterort I—VII." The new harbour bordering the steelworks site is called the "Klöckner Harbour."

The Problem

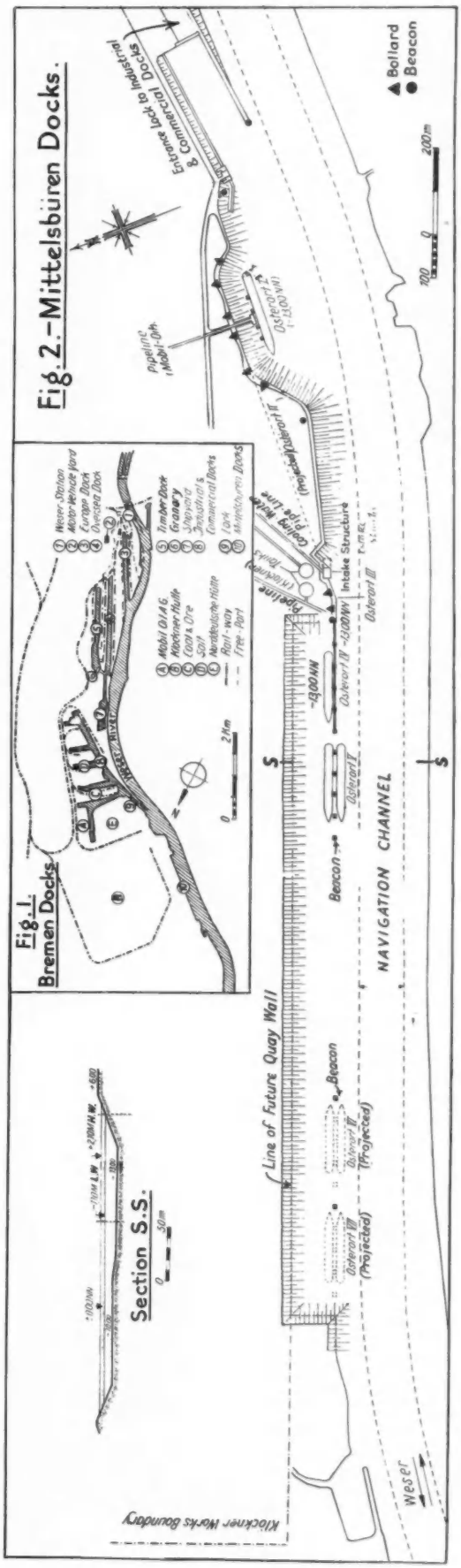
The Industrial and Commercial Docks are a closed dock system. The access lock was built around the year 1910. The effective width of its gates is about 22.50 m., whilst the length of the chamber is 171 m. The sill of the outer head of the lock is at level of −5.97 m. in relation to Chart Datum. Mean high-water level is at +3.30 m., so that vessels requiring a depth of water of up to 9 m. are able to enter and leave the lock.

The Norddeutsche Hütte (marked "E" in Fig. 1) and the Mobil-Oil A.G. (marked "A") had been demanding since 1950 that the necessary facilities be provided to enable their works harbours to be reached by all vessels capable of navigating the River Weser. Compliance with this demand meant that, unless a second and larger lock was to be built, these two undertakings would have to be provided with the necessary berthing and handling facilities **before** the lock.

The owners of the two bulk handling plants—for coal and ore ("C") and for potash ("D") respectively—located in the Industrial and Commercial Docks also demanded an improvement in their situation. It was considered that a useful expedient would be to provide mooring facilities where vessels could discharge part of their cargoes into lighters and then, having thus been sufficiently lightened, proceed through the lock. These mooring berths would at the same time serve as a waiting place for vessels which ascend the river to Bremen with the incoming tide and there have to await the next high tide in order to be able to negotiate the lock in question. The provision of mooring berths is furthermore necessary because at times of crowding of the Port of Bremen—especially in winter—the ships used to have to wait in the Blexen roadsteads, 65 km. away.

To meet the above requirements the following facilities had to be provided:

(a) A works harbour for the Klöckner Concern.
(b) An oil discharging berth for the Mobil-Oil A.G.



The Port of Bremen—continued

Fig. 3. Oil jetty—Osterort I.

(c) Lighterage facilities for deep-draught vessels, which can pass through the lock only after discharging part of their cargoes.
(d) Mooring berths for vessels wishing to enter the Industrial and Commercial Docks and having to wait for the next high tide before being able to go through the lock.
(e) Supplementary loading facilities for outgoing vessels which would not be able to go through the lock in their fully loaded condition.
(f) Waiting facilities for vessels bound for the Free Port.
(g) Facilities for transhipment of cargoes to inland craft.

The Solution

Local conditions imposed certain limitations on the conception and scope of the scheme. Upstream of the development area under consideration are located the Industrial and Commercial Docks. The riverward boundary of the area was constituted by the navigation channel flanked by a 50 m. wide safety strip. Allowance also had to be made for the likelihood that some day a second lock would be built alongside the existing one. The alignment of the bank opposite the berths Osterort I and II duly takes account of the provision of a suitable approach channel to this possible future lock. The construction of such a lock would involve removing the oil discharging berth Osterort I, which would then probably be sited in the approach channel of the present lock.

The solution adopted consisted in the provision of the berths designated as Osterort I—VII and in the construction of the Klöckner Harbour.

Osterort I is a tanker discharging jetty for the Mobil-Oil A.G. and is connected to the refinery by a pipeline. At this berth the level of the bottom is −11.75 m. in relation to Chart Datum (CD), which corresponds to −13.00 m. in relation to German Standard Datum (NN). Vessels coming alongside this jetty are berthed in the same way as at a quay, with the aid of tugs and transportable shore winches (1). The structure consists of a 50 m. long row of four dolphins. In addition, there are six shore bollards designed for a 100-ton pull. The pipe supporting framework is carried on a platform between, but structurally independent of, the two centre dolphins. This platform is connected to the shore by an access bridge consisting of a prefabricated deck which, with the aid of a floating crane, was erected on driven piles serving as piers.

Osterort II is a projected similar oil jetty, whilst Osterort III, which is likewise still in the planning stage, is intended as a berth for use by auxiliary harbour craft.

Between Osterort III and the eastern end of the Klöckner Harbour is located a cooling-water intake structure for the blast-furnace plant. This structure is of interest in that it was built in-situ in the form of a caisson and sunk into its final position (2). It is surmounted by an engine house and a switchgear room.

The comparatively short length of river bank between the intake structure and the Klöckner Harbour is protected by steel sheet piling, along part of which there is a similar depth of water as at the deep-water berth Osterort IV; this provides a deep-water quay where vessels may, in exceptional cases, come alongside for such purposes as loading spare engine parts, etc.

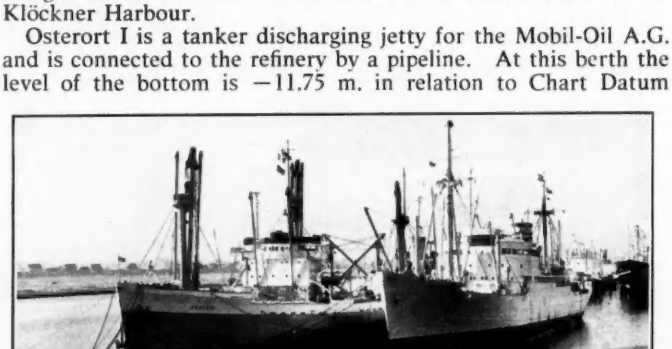


Fig. 4. Osterort IV and V.

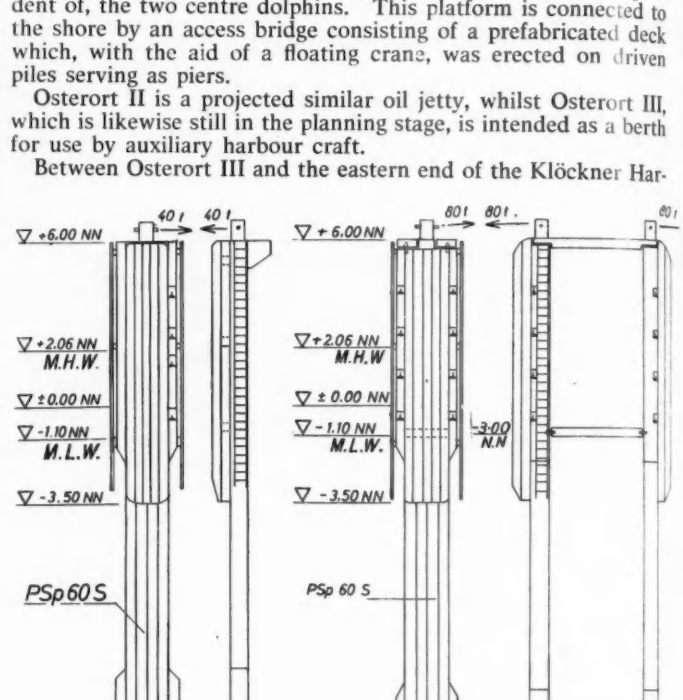


Fig. 5. Dolphin of oil jetty—Osterort I.

Fig. 6. Dolphins—Osterort V.

The Port of Bremen—continued

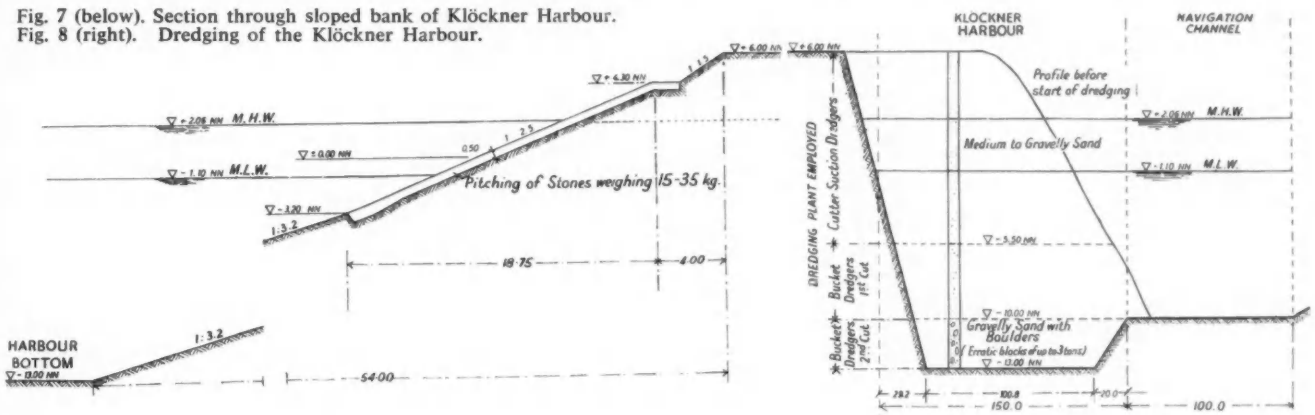
Osterort IV has been designed as a twin berth. A pipeline leads from it to the Klöckner works. Osterort V is a similar structure, except that, unlike Osterort IV, it is not provided with footbridges by way of which the crews of berthed vessels can go ashore. Both structures consist of five pairs of linked dolphins. In the case of Osterort IV the footbridges are carried by piles driven between the pairs of dolphins and are structurally independent of the latter. The bottom level at both berths is −11.75 m. CD.

Osterort IV and V serve as waiting berths and as lighterage berths. The projected berths Osterort VI and VII will serve the same purpose.

The Klöckner Harbour, which is parallel to the river, is 1,600 m. long and 100 m. wide. The bottom level is generally −11.75 m. CD. The banks are at present still sloped and are provided with a protective stone pitching. Keeping pace with the future extension of the steelworks, however, the banks of the harbour will, in successive stages, be transformed into quay walls by the provision of appropriate earth-retaining structures. This new harbour will serve chiefly for the unloading of ore and coal for the blast-furnace plant. Scrap iron and lime will continue to be handled by the existing installations in the older works harbour.

The level of the site for the new steelworks had to be raised before constructional operations could start. The material dredged from the Klöckner Harbour was used for the purpose. Dredging this harbour was effected in three cuts. Economic considerations played a major part in this connection, the basic factor being the capacity of the plant employed. The cuts are shown in Fig. 8; the type of dredging equipment used in each case is likewise indicated. It was possible to pump the dredged material a distance of 800 m. by means of one cutter suction dredger. For greater distances, up to 1,000 m., it was necessary to introduce a second dredger at an intermediate point in the delivery pipeline. For pumping the material to still greater distances, the aid of a stationary electric boosting station on shore had to be called in.

Fig. 7 (below). Section through sloped bank of Klöckner Harbour.
Fig. 8 (right). Dredging of the Klöckner Harbour.



General Considerations with Regard to the Scheme

In their original scheme the Bremen Port Development Authorities had not envisaged siting the Klöckner Harbour parallel to the river, but had intended running it inland at an angle with the river. The Klöckner Concern raised objections to this proposal for reasons connected with the internal operation of their works. A suitable alternative had to be sought. It was, for instance, not possible to construct a new harbour between the site acquired for building the new steelworks and the site of the Norddeutsche Hütte, as this would have disrupted the integral character of the works. Alternatively, a harbour located at the north-western boundary of the new steelworks site would have presented a barrier to future extension. A further reason for wishing to oblige the Klöckner Concern in the matter of the siting of the new harbour was that one of the factors which had led this firm to leave the Ruhr District had been the opportunity offered by Bremen of building on a virgin site free from cramping space restrictions.

Hydraulic model tests were carried out with a view to gaining some information on the behaviour of the River Weser after construction of the Klöckner Harbour. The results of these tests, which were conducted at the Franzius Institute of the Technological University of Hanover, confirmed the Bremen Authorities' assessment of the situation; and now that the new harbour has been in existence for some time, the hydraulic conditions that have actually arisen are in close agreement with those predicted on the basis of the tests.

The Bremen docks are owned by the Municipality, whose policy it must be, in proportion as land is used up in the realisation of new projects, to acquire and "store up" fresh land for future port development (3). In acquiring such land it must be duly taken into account that the requisite areas involved have increased in comparison with former times. The trend of development as manifested by Bremen yields some interesting figures. Thus, in 1908 the firm of Krupp purchased 55 hectares of land with 350 m. of river frontage for the purpose of building the Norddeutsche Hütte. In 1956 the Klöckner Concern acquired 941 hectares of industrial site with a river frontage of 2,300 m. In 1908 the River Weser was navigable by vessels of up to 5 m. draught. Against this, the development scheme under consideration has been based on the present river deepening programme, which is scheduled for completion in 1960 and which will make the Port of Bremen normally accessible to vessels of 8.70 m. draught (and even of 9.60 m. draught, subject to the tidal conditions being suitable). This is to be followed up by further deepening operations, which will ensure normal access for vessels of 10.00 m. draught (and of 10.40 m. draught under the right tidal conditions).

The growth of the needs of the Mobil-Oil A.G., in terms of land, is likewise of interest. In 1911 the refinery was erected on a site 13 hectares in size, which furthermore comprise an oil harbour of 1.5 hectares. In those days the oil intake of the plant was at the rate of 36,000 tons a year. By 1957 the refinery covered an area of 42 hectares, the oil harbour having increased in size to 3.5 hectares, with additional tanker berthing facilities at Osterort I and further projected facilities at Osterort II. The quantity of oil now handled annually by the plant is some 1,500,000 tons.

In conclusion it should be noted that there is nothing unusual in selecting a seaport as a location for a steelworks and rolling mill. The local shipping industry creates a steady demand for rolled steel products, especially plates. Similar considerations govern the choice of Bremen as a suitable place for establishing an oil refinery.

REFERENCES

(1) Hansa 1958, 16/17, p. 848-849.
(2) Technische Blätter der Wayss & Freytag A.G., 1954, p. 47.
(3) R. Lutz, "Planung und Bau von Industrie- und Massenguthäfen an seetiefem Wasser," Hansa 1956, 35/36.

Litigation in the Port Industry

Report on Two Recent Cases

By LAURENCE WEBLEY, LL.B.

Replacing Hatch Covers

Regulation 45 of the Docks Regulations 1934 which deals, among other matters, with the removal and replacement of hatch covers, was discussed in a tragic accident case which came before the Queen's Bench Division last year, Cockerill v. William Cory and Son Ltd. Cockerill, a man of 33 was employed by the defendant company in their coasting collier, the "Corfield." He was an experienced seaman of some sixteen years naval service and shortly after he joined the "Corfield" in 1953 he was promoted her boatswain. He had a wife and two children and made them a substantial allowance from his pay.

The "Corfield" was a self trimming collier of 2,815 tons with four hatches. The hatch openings over her holds were wide and the coamings were about 5 feet above the main deck level. On a Saturday morning in November she berthed at the Commissioners Staiths at North Shields to load a full cargo of small coal. Whilst going up the river, according to the normal and customary practice, Nos. 2 and 3 holds were opened up so as to be available for immediate loading. In fact loading into No. 3 hold started as soon as the "Corfield" tied up.

After the ship had berthed the master, chief officer and three of the deck hands went ashore for the week end leaving the second officer in command. Cockerill was in charge of the deck assisted by a deck boy, age 17, and two shore riggers. During the morning the second officer ordered Cockerill and the deck gang to partially open No. 1 hold to allow for the normal order of loading of this vessel which was Nos. 2 and 3 completely loaded, No. 1 partially and then No. 4. The No. 1 hatch covers were only moved from the middle and after sections, again according to the normal practice on board. Later that morning, however, the berthing master told the second officer that there was no further cargo available and after loading No. 3 the "Corfield" would have to move out to buoys in the stream about a quarter of a mile away for the week-end. Just about noon, therefore the vessel cast off with a tug to take her to the buoys. The process of mooring at the buoys was that springs or wires were run from the forecastle head and the stern, lowered to a boat and made fast to the buoy. A heavy 4½-in. wire, known as an insurance wire, was run from the bows to the forward buoy for additional security. This wire, when not in use, was usually stowed on a reel or drum under the forecastle deck and immediately ahead of No. 1 hatch, from which it could be led up to the forecastle deck and through the bow sheaves.

The ship cast off and the deck boy was on the forecastle deck coiling the spring wires by which the vessel had been moored as the winches drew them in. When he looked back towards No. 1 hatch Cockerill had disappeared and he saw the insurance wire hanging down into the hold. The unfortunate man was found lying at the bottom of the hold on the port side. He died of the fall and in the subsequent action by his widow it was alleged that the defendants were in breach of Regulation 45 because all the covers on No. 1 hatch had not been replaced at the end of the time during which their removal was necessary; namely the period during which the "Corfield" was actually at the loading berth. Regulation 45 reads "no person shall, unless duly authorised or in case of necessity, remove or interfere with any fencing, gangway . . . hatch covering . . . or other things whatsoever required by these Regulations to be provided. If removed, such things shall be restored at the end of the period during which their removal was necessary by the persons last engaged in the work that necessitated such removal."

His Lordship said that Cockerill must have been standing on No. 1 hatch cover and pulling up the insurance wire on to it when he slipped or the wire came away with a run and he fell down the hatchway. Considering the Common Law Liability his Lordship observed that there was no necessity for Cockerill to go on to No. 1 hatch at all in connection with the insurance wire. If any "flaking off" had been required this could have been done in the space between the port side coamings of the hatch and the bulwarks, or on the forecastle head itself. He found there was no breach of Common Law duty.

The allegation that there had been a breach of Reg. 45 was a more difficult branch of the case said his Lordship. The Docks Regulations had often presented very difficult problems for judicial decision and this Regulation was a good example. After dealing with the arguments as to the meaning of the Regulation his Lordship continued that in his view "hatch coverings" in Regulation 45 meant the coverings of any hatch whether the coamings were less or more than 2-ft. 6-in. in height. It had been argued that the words "required by these Regulations to be provided" in Regulation 45 qualified "hatches" as well as the words "other things whatsoever." Accordingly the Regulations should be read "No person shall remove or interfere with any hatch covering required by these regulations to be provided." By Regulation 37 a hatch was only required to have a cover if the coamings were less than 2-ft. 6-in. high. Therefore, it was said Regulation 45 only applied to hatch coverings of the kind mentioned in Regulation 37 i.e. for hatches with coamings less than 2-ft. 6-in. high. He rejected that view. Nor did his Lordship accept that the Regulation meant that the hatch covers were bound to be kept on except when their removal was absolutely necessary. He said he found it impossible to assign any clear meaning to the Regulation or to find in it any obligation which, on the facts of this case, would require that the hatch covers on No. 1 hatch should be replaced before the vessel shifted from her loading berth to the mooring buoys. Accordingly, said his Lordship, "although naturally one's sympathy is with the widow of boatswain Cockerill who was killed in the course of his duty, I have reached the conclusion that liability is not established against the defendants."

This case would, accordingly, appear to clarify two matters; Regulation 45 must be read widely and the types of items to which it refers are not limited by other provisions in the regulations; but the obligation the Regulation imposes to replace these items, hatch coverings and so on, after removal, will be constructed reasonably in the light of the circumstances and not as an absolute obligation. Regulation 45, of course, applies specifically to fencing, gangways, gear, ladders, life saving means or appliances, lights, marks and stages as well as hatches.

Craft Left Unattended

An unusual accident in London docks gave rise to an action against the P.L.A. in the Admiralty Division last year. The "Ladywell" (Hirers and Cargo Owners) v. Port of London Authority. On the 16th August 1955 the steel, swim headed, 77-ft. dumb barge "Ladywell" was made fast to another barge alongside the north wall of the Tilbury Tidal Basin by her lighterman at about noon. There was a moderate breeze and the tide was then flood, near high water. Later the same day, about 1.15 p.m. the "Ladywell" was found lying inside the entrance to the old South West Dry Dock to the northward of the Tidal Basin, with her head about 25-ft. inwards from the entrance and jammed against a chain leading from the quayside to a boom. Her sternpost was wedged against the east wall. The barge was so tightly jammed that tugs were necessary to free her. She was loaded with a cargo of rice in bags and suffered damage due to the severe strain to which she was subjected as the water fell. The boom previously mentioned consisted of baulks of timber with an overall length of about 70-ft., and guarded the entrance channel to the dry dock. It floated at all tides and therefore there was a good deal of slack in the securing chains at high water. This boom was damaged by the action of the "Ladywell."

The plaintiffs, Braithwaite and Dean Ltd., the hirers of the "Ladywell" and the cargo owners, claimed compensation from the P.L.A. for the loss and damage suffered. They alleged the boom was dangerous and inaffective and so loosely connected that craft could penetrate too far into the dock for safety and beyond the area the boom was meant to shut off. They said, among other matters, that the boom was not properly maintained and that the P.L.A. had failed to comply with S.112 of the Port of London (Consolidation) Act 1920 to maintain and repair their docks, basins, entrances and other works.

Litigation in the Port Industry—continued

On the other hand the P.L.A. declared that the plaintiffs were in breach of S.155 of the same Act because the "Ladywell" was made fast and left unattended without permission, was not properly made fast and was, in fact, a trespasser. The case came before the Admiralty Court. Reviewing the evidence his Lordship said he accepted the plaintiff's evidence as to the manner in which their barge was made fast. It was therefore necessary to infer that while her lighterman was away she must have been set adrift by some other craft. But, his Lordship continued, he was satisfied that the "Ladywell" would not have become jammed and been damaged if the plaintiff's lighterman had stayed aboard.

The defendants placed great reliance on S.155 (2) of the Act which provided that no craft should be left unattended without the written permission of the dockmaster. His Lordship pointed out, however, that this rule was habitually disregarded and as the P.L.A. found it a practical impossibility to enforce this statutory provision they hardly ever prosecuted. He referred to the dockmaster's evidence to the effect that he could recall two previous cases of barges becoming wedged in this or the adjacent dry dock entrance channel.

The plaintiffs allege, continued his Lordship, that barges are invited to use the P.L.A. docks. It was, accordingly, the defendants' duty to erect a boom that would make it physically impossible for a barge to get into the dry dock entrance channel.

In his view the "Ladywell" must be treated as an invitee but by not having a lighterman on board she was in breach of the Act. But were the defendants in breach of the duty they owed as invitors? He could not accept the argument that because S.155 (2) of the Act had not been enforced it was, therefore, a dead letter. It had never been repealed and he had been advised by the Elder Brother that the duty was indeed no more than good seamanship would require.

In the circumstances it was going too far to say that the defendants were bound to erect a boom of such a character that even an unattended barge could not get into danger. That would amount to an obligation to make the tidal basins foolproof. The plaintiffs' lighterman had admitted that if he had been been there the accident would not have happened. His Lordship concluded by saying that this was a highly unusual casualty. It had not been proved that the defendants were in breach of the duty they owed the "Ladywell" and the claim would be dismissed.

The deciding factor here was probably the fact that the lighterman's presence could have prevented the accident and, in the circumstances, he might reasonably have been expected to be on board. But it is worth noting that the court would not and could not accept that Sect. 155 (2) was void even though it was virtually unenforceable and in practice not enforced at all. The principle was underlined that dock owners, while they must take reasonable care in connection with craft invited to use their docks, are not insurers and cannot be expected to guard against every unusual type of accident; still less when the vessel concerned could have avoided it by compliance with the Regulations.

River Lee Navigation Improvement

New Lock Opened by British Waterways

A new wide lock on the River Lee Navigation at Ponders End, was opened in February, by Sir Reginald Kerr, General Manager of British Waterways. The ceremony marked not only the completion of the first major project in the £864,000 scheme to improve the River Lee, but also the first major work in the £6 million development programme announced in 1956 for the improvement of British Waterways. The lock, which is capable of accepting barges of 135 tons, has been built alongside an existing lock 16½-ft. wide. It has a width of 18½-ft., a length of 85-ft. and a depth over cill of 7½-ft.

The River Lee, an important London waterway which has been navigable from earliest times and which provides London with about a seventh of the city's water supply, runs from Hertford for 28 miles to the Thames at Bow. It is also valuable for land drainage purposes and as a source of water for the many industrial installations on its banks. There are two entrances to the River Thames, one at Bow via Bow Creek to Blackwall Point, the other opposite the Surrey Commercial Docks via the Limehouse Cut. Near Old Ford Locks there is also a direct connection with the Grand Union Canal and Regent's Canal Dock via the Hertford Union Canal.

Although the River Lee is navigable throughout its length, its substantial and increasing traffic is mainly concentrated on the industrial section between the Thames and Enfield, the volume of traffic on this 13½ mile section amounting to some 2,000,000 tons a year. A substantial proportion of this tonnage is coal for power stations at Hackney and Poplar; the remainder consists chiefly of liquids in bulk (petrol, tar, bitumen, oil), non-ferrous metals and timber. Most of the traffic originates from the Port of London, where it is transhipped by overside discharge from ocean-going vessels into barges owned by some 50 independent carriers. The effect of the new lock will be to open up the whole of this heavily industrial section to the largest craft used by the carriers. This will realise one of the most important objects of the Lee scheme, which aims also at reducing by half the time taken by the large Lee craft in navigating the locks above Old Ford, and to provide fully modern standards of bank protection and dredging. Further duplicate locks are to be constructed alongside the existing Tottenham and Stonebridge Locks, Tottenham, and at Pickett's Lock, Edmonton.

A view of the new lock, looking north.

The lock is fully mechanised so as to enable the gates and sluices to be operated easily and simultaneously, and this will minimise not only the considerable physical effort involved in operating a large lock manually, but will also save time as the movement of a lever in the control cabin on the "island" quay between the new and existing lock will be all that is necessary for the lock-keeper to move a gate or sluice. Hydraulic power is used, oil being pumped by a 5 h.p. electric motor to give a maximum working pressure of 1,000 lbs. per sq. in. The power unit is linked by steel tubing to the gates and sluices, each of which is activated by a double-action piston in a 3-in. cylinder. If this system of operation proves satisfactory, it will eventually be applied to the lower locks on the Lee.

The new lock was designed by Mr. V. H. Tripp, B.Sc., M.I.C.E., Divisional Engineer of British Waterways' South Eastern Division, who also supervised its construction by Messrs. A. E. Farr Ltd., Civil Engineering Contractors, Westbury, Wilts. The work, completed in twelve months, involved the excavation of 5,000 cu. yds. of earth and gravel, the placing of 1,600 cu. yds. of concrete and the driving of 5,500 sq. ft. of steel piles.

St. Lawrence Seaway Tolls

Confirmation of Rates recommended by the Joint Tolls Committee

At the time of going to press, information has been received that agreement has been reached between the governments of Canada and the United States on the toll rate structure for the St. Lawrence Seaway. They have confirmed their acceptance of the recommendations of the Joint Tolls Committee of the two countries announced last June. These provide that a ship moving through the entire Seaway will pay 6 cents per gross registered ton together with a charge of 42 cents a ton on bulk cargo and 95 cents per ton on general cargo. The tolls are to take effect on April 1st. Charges will be payable within 14 days of billing, and there will be a maximum surcharge of five per cent. on overdue payments. The tolls are designed to pay off the construction debt of the Seaway ($451 million) in 50 years.

There is provision in the agreement for a joint advisory board of four members to hear complaints and make recommendations on them to the Canadian and U.S. Seaway Agencies. The agreement also provides for a review of the charges in five years following a report on their operation by Canada's St. Lawrence Seaway Authority and the United States' St. Lawrence Seaway Development Corporation.

The division of tolls between Canada and the United States will be on the basis of their respective investments in the Seaway. Canada will collect all charges on vessels going through the all-Canadian Welland Canal between Lake Ontario and Lake Erie, on which she is spending an estimated $29 million for the Seaway. The Welland tolls will be based on this cost — not on Canada's original investment in this canal.

On the remainder of the Seaway—between Montreal and Lake Ontario—Canada and the United States will receive, respectively, 71 and 29 per cent. of collections. The respective investments in this portion are $300 million and $122 million as estimated now. Canada will have the responsibility for collecting all tolls, through the Seaway Authority at Cornwall, Ontario, but the United States will participate in some of the financial operations and share in the cost.

As originally recommended by the Joint Tolls Committee of the two countries, the domestic package goods traffic—both in Canada and the United States—will receive a financial benefit over international carriers. Point-to-point traffic within Canada and within the United States in package commodities will be billed the same as bulk cargo, which will carry rates about half that of normal package trade.

The tolls are: For the entire Seaway between Montreal and Lake Erie: Six cents per registered ton of each vessel plus 42 cents per ton on bulk cargo and 95 cents per ton on general cargo.

Between Montreal and Lake Ontario: four cents per registered ton plus 40 cents bulk and 90 cents general. For partial transit of this seven-lock stretch, 15 per cent. of the complete toll for each lock.

Welland Canal: Two cents per registered ton, plus two cents bulk and five cents general. For partial transit of the Canal, half the full charge regardless of how many locks used.

Commercial Passengers: Fifty cents for each lock, or seven dollars 50 cents for the whole passage.

Pleasure craft: Same rate as other vessels, except that the minimum will be $2 per lock instead of $4 for all other vessels.

The charges will apply to all types of ships—including Government-owned or Government-operated vessels—except those owned or employed by the Seaway agencies.

Bulk cargo as defined in the tariff of tolls includes such goods as are loose or in mass and generally must be shovelled, pumped, blown, scooped or forked in the handling and includes barley, buckwheat, corn, dried beans, dried peas, flaxseed, rape seed and other oil seeds, flour, grain screenings, mill feed containing not more than 35 per cent. of ingredients other than grain or grain products, oats, rye and wheat, cement, coke and petroleum coke, domestic package freight; liquids carried in ships' tanks; ores and minerals, including alumina, bauxite, coal, gravel, phosphate rock, sand, stone and sulphur; pig iron, scrap iron and scrap steel; pulpwood, poles and logs; raw sugar; and woodpulp. All commodities not included in the definition of bulk are classified as general cargo. The agreement permits changes in the list of goods defined as " bulk cargo."

The Tolls Advisory Board will consist of two appointees made by each of the Seaway Agencies. Canadian and United States chairmen will alternate every six months. In case of a tie vote, the chairman will have the deciding vote.

Manufacturers' Announcements

Xenon Lamp Experiment at Lighthouse

The main revolving navigation light of Dungeness High Lighthouse on the south coast of England has been replaced by a non-revolving flashing light of similar intensity and characteristics but whiter colour. The light is a Mazda 2 kw. high pressure Xenon discharge lamp of a type developed by the A.E.I. Lamp and Lighting Company Ltd. It has been housed inside a small lens on the roof of the lighthouse and is operated by experimental control equipment made by Trinity House Research and Development Section. It is likely, if the experiment is a success, that Stone Chance Limited, the lighthouse engineers, will produce a prototype equipment during the year.

The principal advantage of the new equipment is the substantial reduction in size and complexity of the optical arrangement and in addition a reduction of the power required to operate the light.

Many lighthouses are equipped with continuously burning paraffin vapour burners with large revolving lenses which condense the light into beams which sweep round like the spokes of a wheel and are seen as flashes by distant observers. These lenses are formed of panels containing carefully ground glass mounted in gunmetal frames, the whole structure floating in a trough of mercury and rotated by a mechanism driven by falling weights rewound periodically by hand. Some of these lenses are 9-ft. in diameter and weigh 5 tons.

More recent installations have continuously burning tungsten filament lamps and, in such cases, the revolving lenses are much smaller and are rotated by electric motors.

A small non-revolving lens is used with the new lamp because the light source is small but intense and may be flashed on and off instantaneously at a power of 2,000 watts at the correct intervals. Dungeness Lighthouse flashes for 1.3 seconds every 10 seconds and the new lamp and control gear will ultimately consume only about 300 watts while a continuously burning tungsten filament lamp providing the same light with the aid of a revolving lens would probably consume 1 kw. The electricity supply to the equipment is by batteries which may be trickle charged from the mains, or, in isolated or off shore lighthouses, by small diesel generators.

Trinity House has lighthouses varying in power from 100,000 to 5-million candle power. The new experimental light at Dungeness is expected to have a power of between 750,000 and 1-million candles and it is expected that a combination of circuit modification and lamp and lens design improvements will later yield as much as 5-million candle power.

New Anodes for Cathodic Protection

Although virtually immune to corrosion in brine, titanium itself is not a suitable anode material, because the protective oxide film which forms on its surface resists the passage of an electric current. If current is forced through by the use of high voltage, the film breaks down and severe local corrosion develops. Research has shown, however, that this high surface resistivity is very much reduced when a second metal is attached to the surface. In particular, a combination of titanium and platinum forms a most effective anode material.

While most of the current is carried by the platinum, the amount passing through the titanium is sufficient to bring about the anodic polarisation of the metal, ensur-

Manufacturers' Announcements—continued

ing that the oxide film is continuously maintained. Even if the platinum coating is discontinuous, there is no corrosion of the titanium exposed to the electrolyte. This means that an anode material is now available which offers the advantages of platinum at much lower cost.

Platinised titanium offers a new anode material which, according to the makers, is very nearly ideal for the cathodic protection of steel structures in sea or estuarine water. Anodes which are completely non-consumable can be made from titanium in a wide variety of wrought forms and, because they can be operated at current densities far higher than are possible with conventional materials, much smaller anodes can be used.

These anodes, which have been developed by Imperial Chemical Industries, Ltd., are being used to protect a jetty at Thames Haven, where 15,000 sq. ft. of steel piling is being protected by four small platinum titanium anodes measuring only 2-ft. long by $\frac{7}{8}$-in. diameter. These have been in operation for six months.

Diesel Tug for P.L.A.

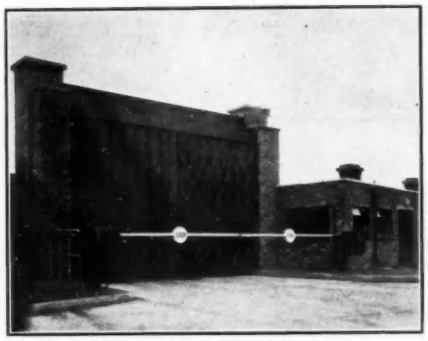
James Pollock Sons & Co. Ltd., Faversham, recently launched the diesel-engined tug "Lord Devonport," one of three powerful tugs under construction for the Port of London Authority. They are to be used for the Authority's new project for the disposal of mud dredged from the River Thames. The dredgers will discharge the mud into hopper barges, which in turn will be towed by the three tugs, and put alongside a large pumping plant — also under construction at the Faversham yard— which will pump the mud ashore from the barges. The tugs have also been designed for estuarial duties and will be used for towing the hopper barges to sea in cases of necessity.

The "Lord Devonport" has a length of 77-ft., a beam of 21-ft., and a draft of 10-ft. Propelled by a 930 h.p. unidirectional diesel engine built by British Polar Engines Ltd., the tug is of the most modern type, with bridge control so that the master is entirely responsible for the operating and manoeuvring of the vessel. She is fully equipped with auxiliary machinery, two generator sets, compressor sets, oily water separator, and all modern units that go into the installation of a present day tug.

Remote Control Traffic Barrier

A new electrically operated Traffic Barrier has been designed by Bolton Gate Co. Ltd., for the remote control of factory entrances, railway and pedestrian crossings, and other location where traffic control is essential to safety.

The standard barrier is supported on rolled steel channel posts by means of self-aligning ball races in rigid plummer block housings. The boom, a 3-in. diameter, aluminium alloy tube, is accurately counterbalanced by cast iron weights. To avoid



The new Traffic Barrier installed at Clyde Wharf, London.

damage to the mechanism in the event of it being hit by a vehicle, the barrier is designed to swing through a horizontal plane.

Also available is a barrier fabricated from 6-in. x 1-in. aluminium alloy sections complete with 1-in. x $\frac{1}{4}$-in. aluminium alloy under lattice, which automatically folds flat as the barrier is raised, to give maximum clearance.

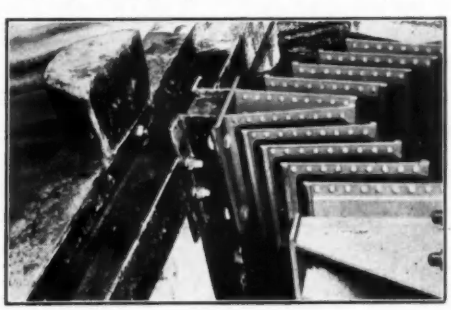
Both standard and lattice models are powered by a fan cooled motor driving through a special double worm reduction gear. Drive to the barrier spindle is via an overload clutch coupling which is adjusted to prevent damage should the barrier be obstructed during descent. Special limit switches which automatically cut-off the motor at each end of travel are incorporated, the whole driven mechanism being housed in a sheet steel case securely fixed to the main frame.

The Raykin Fender

An interesting feature recently developed by the Andre Rubber Company Limited is the Raykin Fender, a rubber sandwich that gives positive all-round protection to harbour installations.

The fender consists of a series of sandwiches of a specially developed natural rubber compound set between steel plates. The assembled sections are arranged in an inverted "V" formation so that any force acting against the fender tries to flatten out the "V," putting the rubber sandwiches in shear, the resistance producing a gentle cushioning action that absorbs energy at a very high rate, eliminating risk of damage to hull plating and harbour installations.

There is nothing in the Fender to jam; it



The Raykin Fender Unit.

is always ready for use, and requires the minimum of maintenance during service. Components are virtually unaffected by corrosion, rotting or ageing as, in addition to coatings of primer, multiple coating of neoprene are applied. Sandwich assembly bolts, nuts and washers are cadmium plated, and the fender's design prevents abrasion.

Each unit is supplied as a complete assembly so that final installation to main pier structure is simple, rapid and inexpensive, and can be made to meet practically all problems of energy absorption.

New Elapsed Time Indicator

Messrs. Cass and Phillips Ltd., Herts have been co-operating for some time with atomic energy, aircraft and industrial authorities in adapting the design of their elapsed time indicator to make it a completely sealed, insulated and waterproof unit.

The elapsed time indicator is an instrument which registers the true operating hours of a vehicle or a machine. This information is invaluable when assessing maintenance requirements. In addition, knowledge of the load or utilization factor of cranes, fork lift trucks, machine tools, and production equipment of all kinds is essential for working out the most effective methods of daily operation.

The new version is designed with a double-skin instrument case, the mechanism being mounted internally on beryllium copper-leaf springs. The balance staff, balance wheel and armature assembly are jewel mounted. Apart from being completely sealed against ingress of water and dust, the instrument movement is electrically insulated from the case and, therefore, the case does not provide a connection to earth as on earlier models.

Elapsed time can easily be read in hours and minutes to the nearest 15 seconds, and timing accuracy is better than 15 seconds in 24 hours.

Diatube Diamond Drilling Equipment

L. M. Van Moppes and Sons, Limited recently announced the formation of Holemasters, Ltd. to handle the sale, hiring, and contracting, of "Diatube" diamond drilling equipment which has been developed to drill clean accurate holes in materials normally hard to penetrate with conventional tools.

Diatube is a rotary drill needing fairly light loads to cut efficiently, thus, there is no risk of causing any structural damage to buildings. As the drill cuts the exact hole diameter required, time and expense spent in making-good is eliminated.

The equipment which is based on the same principle as that used for rock drilling operations can be economically applied to such materials as Flint, Brick, Concrete, Granite and Quartz.

The assembly is simple to operate and for small sizes, up to $1\frac{1}{2}$-in. O.D., requires only a conventional power-driven hand drill. Where the nature of the work requires

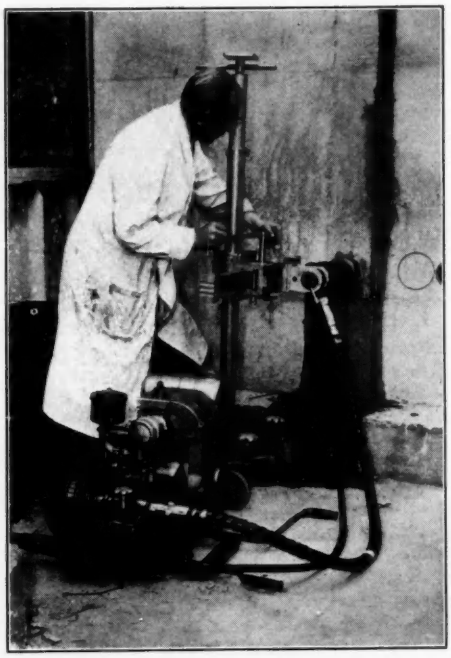
Manufacturers' Announcements — continued

taking larger cores, the same assembly can be transferred to a normal drill press or the specially designed drill stand. The cutting tool is a tubular drill tipped with diamonds set in a hard metal matrix, and can be supplied in lengths up to 24-in. Drills up to 1-in. O.D. are available with either ¼-in. or ⅜-in. B.S.P. female threads and drills above 1-in. O.D. are plain machined to receive expanding adaptors.

Most electric drill units, petrol and air motors of the rotating type can be adapted for use with Diatube, the main considerations being the spindle speed and whether the unit has sufficient power for the size of drill it is intended to use.

The equipment has already been successfully used in maritime work. During the setting of foundations for two dolphin piers at Texada Island, B.C., Canada, a contractor was set the problem of drilling in granite bedrock, ten holes 8-in. dia. x 60-in. deep accurately located to within 3-in., under 60-ft. of water in an area subject to heavy weather.

Drilling to the required accuracy from the surface would have been impossible with conventional methods; in fact, weather conditions made it necessary to bring the drilling machine to the surface every night. Additional difficulties arose when the bedrock was found to be badly fractured due to blasting and earthquake action. Preparation for drilling included setting two large concrete rings on the bottom for retaining walls for removal of normal surface mud. Drill hole centres were then located by instruments and templates. A steep grade in the bedrock necessitated the building of a concrete platform at each hole site; the Diatube machine was anchored on this platform by a chain attached to two Lewis pins in the rock.



Heavy duty drill and stand

Only four Diatube bits were used for the entire operation and the actual drilling time for each hole was 89 minutes. A high pressure jet pump fed water to the diamond bit and a 225 cu. ft. compressor supplied power for the drill.

Holes were drilled to within one inch of the specifications, a remarkable accuracy since the underwater visibility was zero. The contractor reported that the underwater work was faster, more accurate and cheaper than drilling from a rig mounted on a scow and that underwater diamond drilling is practical at depths of up to 200-ft.

Cathodic Protection of Mooring Buoys

Lambert Garland Mooring Buoys Ltd., through their principal agents, Wm. McNeil Ltd., of Glasgow, have placed orders with M. G. Duff and Partners Ltd., Chichester, for the Cathodic Protection system on "Lamgar" Mooring Buoys, to be delivered to the Aden Port Trust. Considerable interest is being shown by manufacturers and users in the cathodic protection of buoys as the most suitable way of preventing underwater corrosion. Orders for buoyage protection are in hand from: Chance-Londex Ltd., Weymouth Town Council, and Nigerian Ports Authority.

APPOINTMENT VACANT

PORT OF PRESTON AUTHORITY
(County Borough of Preston)

Applications are invited for the post of ASSISTANT ENGINEER (CIVIL) in the Chief Engineer's Department of the Port of Preston Authority. Candidates should be Corporate Members of the Institution of Civil Engineers or hold equivalent qualifications, and have good experience in design, specifications, construction and maintenance of civil engineering works. Dock and Harbour experience is preferable but not essential.
Salary Grade A.P.T. IV. (£1,025 x 25 — £1,175).
The appointment will be subject to the Local Government Superannuation Acts, to the National Scheme of Conditions of Service, and to one month's notice on either side.
Application forms may be obtained from the undersigned, to whom they should be returned not later than 31st March, 1959.
Municipal Building, W. E. E. LOCKLEY,
Preston, Lancs. Town Clerk.

FOR SALE

TWO TON MODERN ELECTRIC FORK-LIFT TRUCK with 9-ft. lift.—B. G. PLANT (SALES AGENCY) LTD., Watlington, Oxfordshire. Tel.: Watlington 44.

ONE DOCK ROLLER GATE complete with electrically operated motor, gear, etc., also guides and footbridge. Manufactured by Messrs. Ransomes & Rapier, 1930, all in good condition. Size approximately 23-ft. wide x 16-ft. high. Offers.—Box No. 216, "The Dock and Harbour Authority," 19, Harcourt Street, London, W.1.

RAILWAY TURNTABLE—Mundt type standard gauge turntable 65-ft. long, carrying capacity 150 tons approx.
WATER CRANE—3,000 gallon water crane.
TURNOUTS—Twenty 1 in 8 turnouts in 75 lb. F.B. rail; interchangeable to suit LH or RH.
All these items are in excellent condition.
Apply Eagre Construction Co. Ltd., East Common Lane, Scunthorpe, Lincs. Phone 4513.

SHOT BLASTING

SHOT BLASTING and metal spraying in situ by the "on-site" experts. Anything, anywhere at competitive rates. Darnall Shot Blasting Co. Ltd., Doctor Lane, Sheffield, 9. Tel.: 42896.

FOR SALE OR HIRE

FORK LIFT TRUCKS of every description FOR SALE OR HIRE, including 7-ton Ross 25-ft. lift, 1-ton Electrical Battery Runabout, 2-ton Lister Platform Trucks, 6,000 lb. Ross, etc., etc. B.G. Plant (Sales Agency) Ltd., Watlington, Oxon. Watlington 44.

FOR SALE and/or CHARTER

Self-propelled oil-fired BUCKET DREDGER 770 Litre. Hull 53 x 9·75 x 4·25 M.
TWO HOPPER BARGES 400 M3. Dim. 47 x 8 x 3·10 M.
Seagoing DIESEL TUG 400 HP. Built 1949. Dim. 24·75 x 6 x 3·30 M.

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Sworn Brokers for Dredging and Floating Equipment.